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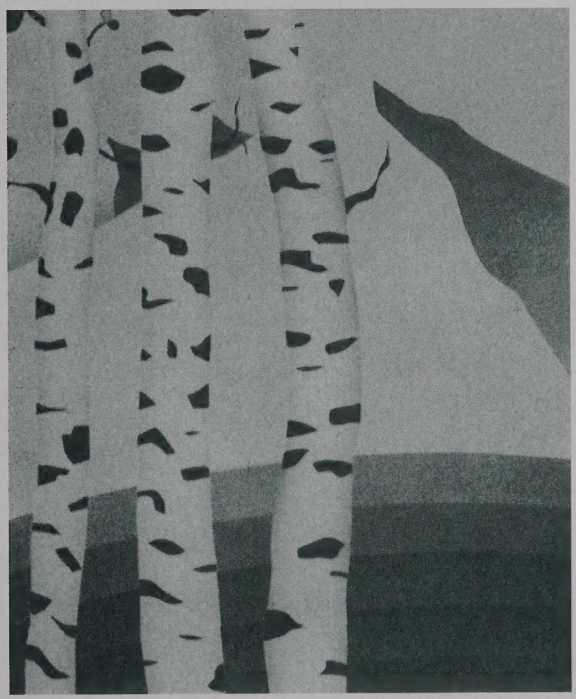

Natural Resources and Environmental Issues

Volume V
1995

Caretakers of the Earth

Utah State University
College of Natural Resources

Proceedings of the Symposium

Ecosystem Management of Natural Resources in the Intermountain West

April 20-22, 1994
Eccles Conference Center
Utah State University

Edited by

Frederic H. Wagner

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Natural Resources and Environmental Issues
Volume V
1995

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The Symposium Planning Committee wishes to extend its appreciation to the personnel of the Conference and Institute Division for its manifold assistance to this symposium: registration services, travel arrangements, financial accounting, food arrangements, services associated with use of the Eccles Conference Center, and audio-visual services. In particular, the strong commitment and professionalism of Lisa B. Anderson and Amy K. Kunz contributed immeasurably to symposium's success.

Natural Resources and Environmental Issues is a series devoted primarily to research in natural resources and related fields. This series is published by the College of Natural Resources, Utah State University, Logan, Utah 84322-5200, and is distributed by the S. J. and Jessie E. Quinney Natural Resources Research Library.

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ISSN 1069-5370

Series Foreword

The College of Natural Resources recognizes the important role it has in educating natural resources managers and leaders who can provide the guidance and knowledge needed to increase the production of the earth's renewable resources while sustaining and enhancing the global environment and the natural resources base. The College's teaching, research, extension, and service efforts focus on the many aspects of sustained multiple-natural-resources management and their relationship to man. Through its many programs, the College of Natural Resources focuses on solving local, state, national, and global problems to enhance a more efficient and contemporary use of the world's natural resources.

Since 1930 the College of Natural Resources has offered several publications of various kinds to disseminate technical and popular information about natural resources and the environment. These publications have included *The Utah Juniper* (1930–1970), which started as a technical publication and evolved into a popular format and ultimately into the College's yearbook; *The Edge* (1978–1980), which was intended to be popular in format and highlighted faculty research efforts; and most recently, *Resource Lines* (1989–present), a newsletter about the College of Natural Resources and its programs, faculty, students, alumni, and friends.

The publication begun in 1993, *Natural Resources and Environmental Issues (NREI),* is a technical series that addresses current topics relevant to natural resources and to the environment. The journal is published as a series of volumes, with at least one being issued each year as the proceedings of the Natural Resources Week symposium. Publication in *NREI* is by invitation only.

The management of global natural resources depends on our ability to obtain and disseminate pertinent information in a timely manner. Equally important, the information should reflect current issues of concern to natural resources and environmental managers as well as to the public. Through *NREI* the College of Natural Resources will provide information on timely topics of broad concern to professionals and to society as a whole.

Joseph A. Chapman, Dean
College of Natural Resources

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FOREWORD

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Each April, the College of Natural Resources at Utah State University holds a symposium on an important natural-resources or environmental topic. In 1994 the symposium addressed Ecosystem Management in the Intermountain West. It was sponsored by the Utah Department of Natural Resources and the College of Natural Resources, and cosponsored by numerous federal and state agencies, university programs, and the S.J. and Jessie E. Quinney Foundation. As a group they endorsed the importance and timeliness of this topic.

People have always been at the center of natural-resources management. But in the past, acknowledgement of their role in the ecosystem, and as participants in decision-making processes that affect management, has at times been limited. As a society, we are becoming more urbanized, informed, and environmentally conscious. Management of natural resources principally for the production of marketable commodities, characterized by the conservation era (1900-1970), has shifted because of a changing public with its increasingly diverse needs. Natural-resources agencies have responded by addressing a broader scope of concerns as we have moved into the environmental era, characterized by stronger interests in wildlife, recreational opportunities, biodiversity, and ecosystem management. Agencies are being restructured to deal with these broader concerns. This requires a different perspective on the part of natural-resources professionals, the public, and their elected representatives.

Ecosystem management is an attempt to address these changing social values, and to include a wider, more diverse spectrum of natural-resources and environmental values. Ecosystem management as a concept attempts to treat large land and water areas and the associated biotic communities as more inclusive, interrelated systems. The size of the system depends on the issues addressed. The essence of ecosystem management is sustainability: the capacity to provide products and amenities over a long period of time with little or no damage to the basic integrity of the natural system involved.

To be fair, ecosystem management has not been fully endorsed or defined. Currently, agencies, professional societies, and the public are working to better define the ecosystem concept and make it operational. There is a critical need to understand the full range of public natural-resources values and how to help integrate these values into management decisions. For this reason, the concept of ecosystem management undoubtedly will continue to evolve.

The goals of ecosystem management will have to be defined and clearly articulated. However, ecosystem management can only be approached in an interdisciplinary and collaborative mode. Universities, agencies, legislators, industry, and advocacy groups need to work together and form new partnerships to address the complex, multifaceted issues concerned.

I remain very optimistic about the future of natural-resources management as we attempt to deal with new and often controversial issues. As professionals, society depends on us regardless of our professional affiliations or personal values. Ecosystem management provides a broad, multidisciplinary framework in which complex environmental problems can be addressed. I hope these proceedings will help to clarify and focus future discussions on ecosystem management.

INTRODUCTION

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As ecosystem management emerges as a dominant natural-resources management paradigm, it is likely to encounter some of its greatest natural-scientific and socio-political complexity in the Intermountain West of the United States. Natural environments range from arid desert basins through forested montane zones to alpine tundra; and from sparkling mountain streams and lakes to large rivers, major impoundments, and saline lakes. All are interconnected biologically and hydrologically. Decisions affecting any one are likely to influence the others.

In fairly limited areas that could be designated as ecosystems to be managed, land ownership and management may include a mix of four or five federal agencies, Native American tribal lands, state land, and private holdings. The states of the region are politically conservative, and sensitive to the degree to which major public-land ownership preempts their autonomy and prerogatives for making landuse decisions within their borders. With two-thirds and 85 percent of their areas in federal ownership, Utah and Nevada, respectively, are prime examples. That sensitivity to government solutions will always complicate ecosystem-management decision making.

Historically, many of the region's local economies have been based on commodity extraction of the natural resources: livestock grazing, timber cutting, hydropower production, mining, and irrigated agriculture. But the region's population is the fastest growing in the country, and the new arrivals are concentrating in urban areas. As a result, what have historically been low-population, rural states are now classified as urban. With a mere 2 million people in 85,000 square miles, Utah is now the sixth most urban state in the nation.

The new, numerically dominant subcultures in the cities attach different values to the region's natural resources, values which often are not compatible with the traditional ones. The new citizenry also frequently charges that the traditional landuses have not been sustainable. The resulting urban-rural tensions add to the difficulties of reaching compromise ecosystem objectives.

Fully aware of these difficulties confronting ecosystem management in the region, Ted Stewart, Executive Director of the State of Utah Department of Natural Resources, and Joseph A. Chapman, Dean of Utah State University's College of Natural Resources, jointly conceived in fall 1993 the idea of holding a symposium on the subject. Since the College holds a symposium on some timely issue each April as part of its annual Natural Resources Week, the decision was made to devote the 1994 symposium to Ecosystem Management of Natural Resources in the Intermountain West.

Frederic H. Wagner, Associate Dean of the College, was asked to plan and organize the effort. He asked one faculty member from each department in the College to serve on a planning committee: Mark W. Brunson, Department of Forest Resources; John A. Kadlec, Department of Fisheries and Wildlife; John C. Schmidt, Department of Geography and Earth Resources; and Neil E. West, Department of Rangeland Resources. The symposium was held on April 20-22, 1994, and this volume is the proceedings, containing written papers of all of the presentations.

The committee reviewed proceedings of the many recent ecosystem-management symposia. Since there had been a strong tendency to emphasize the ecological aspects of the paradigm in most of these, the committee decided to give more consideration to the policy aspects. While not in any way discounting the natural-scientific complexities, the group believed that the socio-political hurdles to implementing ecosystem management in the region could be even more daunting, given its complexity.

Consequently the committee decided to orient the symposium around four questions or themes which it believed to be central to implementing the new management approach:

(1) What is ecosystem management?
(2) What are the technical, natural-scientific problems of implementing ecosystem management on the ground?
(3) What social and political mechanisms will bring disparate groups together into agreement on management goals?
(4) What are the legal and administrative problems surrounding the issues of multiple land ownership, federal, state, and private?

Following a broad-perspective overview of ecosystem management, the conference was divided into four half-day sessions. Session 1 on the morning of April 21 presented one paper each on the above four themes, in effect setting forth the principles surrounding each. Session 2 in the afternoon presented four case studies of areas engaged in, or attempting, ecosystem management. These included areas centering on timber-production, grazing, a national park, and an aquatic system. The speakers were asked to address the four conference themes in the course of their presentations.

In Session 3 in the morning of April 22, the conference

attendees subdivided at their option into three break-out discussion sessions to deliberate the promise and problems of ecosystem management in three major geographic areas of the Intermountain West: Colorado Plateau, Northern Rocky Mountains, and the Great Basin. Composition of the groups reflected overall attendance at the symposium: public-agency employees, academics, representatives of environmental and commodity groups, and other interested individuals. The groups directed their discussions to three characteristics of each region:

(1) The unique biophysical and social characteristics.
(2) Factors likely to be constraints on ecosystem management.
(3) Factors likely to enhance the prospects for ecosystem management.

The groups were asked especially to bear in mind, during the course of their discussions, the four questions on which the symposium was focusing.

On the final afternoon, in Session 4, administrators of three federal, natural-resources agencies and Executive Director Ted Stewart of the Utah Department of Natural Resources presented their perspectives on ecosystem management. Three of the five speakers had advanced to the directorships of their organizations within the preceding two years. Hence they were informing the symposium of the role they intended their agencies to play in ecosystem management in the years ahead, and in the process contributing momentum to its emergence as a prevailing natural-resources management paradigm.

A group of 17 graduate students in the College of Natural Resources subdivided into four groups assigned to attend all of the sessions. Each group recorded and synthesized the comments of all of the speakers on one of the four themes of the conference. Except for Session 1, the speakers in all of the other sessions covered a wide range of topics beyond the four themes. The four syntheses attempt to extract out those comments relevant to the themes, and they are combined in a section of these proceedings immediately following the papers of Session 4.

Finally, the proceedings close with an epilogue that attempts to distill the general principles of, or insights about, ecosystem management that emerged from the presentations and discussions of the sessions.

OVERVIEW

Factors Influencing the Context and Principles of Ecosystem Management

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Abstract

The earth's population has grown eleven-fold in the last 300 years, therefore there are fewer resources and less space available for each individual, living thing: hence the biodiversity crisis. Human use of resources has increased at a greater rate than population growth. Agricultural and natural resources use and efficiency gains will be required to stop ecosystem degradation. All ecosystems have biological and physical limits, are complex and interconnected in space and time, are constantly changing in only partially predictable ways, and are renewable. Sustainable development, though a nebulous statement of intent, affirms maintaining healthy, productive land and natural resources.

Ecosystem management can be defined as the process of seeking to produce (i.e., restore, sustain, or enhance) desired conditions, uses, and values of complex communities or organisms that work together with their environments as integrated units. The working guidelines for implementing ecosystem management include the key steps of delineating ecosystems, statements of problems, assessing and understanding choices, and acting, learning, and adapting. The necessary steps are getting people involved; working within the scope of the processes; integrating information, technology, management, and research; revitalizing conservation education and interpretation; and, developing, monitoring, and evaluating vital signs of ecosystem health. Biological diversity, the variety of life, is valuable within an ecosystem for ecological, economic, educational, and aesthetic reasons and, thus, its conservation should be included in ecosystem management.

To fully shape ecosystem perspectives in land and resource management, social, biological, and physical sciences must become better integrated. By using the working principles of the model known as adaptive management, ecosystem management can develop a new model for the scientific basis of conservation—interdisciplinary teams working with all constituencies to address both short- and long-term relationships between people and the land.

A GLOBAL PERSPECTIVE ON PEOPLE, LAND, AND RESOURCES

During the past 300 years—since the industrial revolution—the global human population has grown by 11-fold. Where 500 million people once lived, there are now more than 5.5 billion people. These 5.5 billion people are spreading out into more and more of the earth's land spaces. They are using more and more of the earth's natural resources with every passing year. And they, we actually, are increasingly changing the structure, composition, and function of terrestrial, oceanic, and freshwater ecosystems. These realities and their various ramifications dominate how and for what earth's ecosystems are managed. They will continue to dominate as far into the future as we might care to plan.

A simple and unavoidable fact of ecology is that every living being on earth uses space and resources to survive. The more of any particular species there is, the more space and resources are directed toward that species' existence. Thus, 11-fold growth in the global human population means that people use an increasing share of earth's space and resources. One way to envision this is "earth per person" over the years: there is now only one-eleventh the amount of earth's space per person as there was at the dawn of the industrial revolution. Hence the increasing strife—gang warfare in some cases—between competing segments of society in countries the world over (Kaplan 1994). It also means that less space and resources are now available for all the other living things on earth except for those that benefit from human-modified habitats. Hence, the so-called biodiversity crisis (Wilson 1992). These are some of the global implications of the human population and its effects on earth's ecosystems. Local dimensions are often scaled-down versions of the global situation.

According to data cited in the book State of the World 1994, human impacts on earth's ecosystems are far from stable; they are accelerating as the global human population has doubled in the last 40 years. As a direct consequence of this doubling, plus technological advances, our collective economic output has increased 5 times; use of oil has grown 6 times; industrial wood production has doubled and is now exceeded in volume by the use of wood for fuel; use of water has tripled; and the gap between affluent and poor people has doubled (Postel 1994). Using various international data sources, Postel projects significant downward global trends in basic resources between 1990 and 2010 as the human population grows by another 33% and continues to appropriate more space and resources to meet its needs and desires (Table 1):

- Fish catch is predicted to increase by 20% but on a per-capita basis this will represent a 10% decline because of population growth.
- There will be 17% more irrigated land but this is a per-capita decline of 12%.
- Cropland will increase 5%, yielding a per-capita decline of 21%.
- Pastures will increase by 4% for a per-capita decline of 22%.
- Forests will be where most of the cropland and pastures come from, declining by 7% for a per-capita reduction of 30%.

Humans will continue to appropriate more of earth's space and resources. Yet, because of inequities in affluence and distribution of food and material goods, not all people are likely to benefit equally from the fruits of economic development. Ecologists should pay as close attention to the political ramifications of this likelihood as they do to its biological ramifications because nature's ecosystems and their biological diversity rarely if ever fare well during times of war.

With less land available per person to meet the burgeoning needs of people for resources, significant improvements—efficiency gains if you will—will be required in agricultural and forest productivity on lands devoted to those purposes. Even greater gains in water-use efficiency and recycling will be needed. Otherwise, ecosystems now in use for resource production will be further degraded and more native ecosystems will be overrun by human uses. Thus, global trends in population growth and resource use mean that the work of natural-resource management is going to become harder and more important as time goes on. Whether the projected trends are precise is not critical. What is important is that we understand the direction and magnitude of these trends as driving forces of ecosystem management.

This paper explores ecosystem management based on the premise that the human population will continue to grow and that people will continue striving to improve their material standard of life. Other fundamental premises are possible, though I doubt very realistic. For example, philosophical arguments can be waged about whether the human population is already too large or whether segments of it should have their access to desired resources constrained. I do not question the usefulness of such arguments but they will not be waged here. The reality of recent and projected trends is what natural-resources managers and scientists must confront.

THINKING ABOUT ECOSYSTEM MANAGEMENT

More than 40 years ago, American forester and wildlife biologist Aldo Leopold said that people should take care of land as a "whole organism" and try to keep all the cogs and wheels in good working order (Leopold 1949). If we humans did this, he implied, the productivity and renewability of land for the many things we value would fare well, for example timber yield, water quality, wildlife, scenery, and livestock forage. What Leopold had in mind, I think, was to sustain the diversity and productivity of ecosystems while still meeting people's needs for livelihood. Lately, natural resources scientists and managers in the United States have begun to call this holistic concept ecosystem management. It encompasses or is directly linked to several other natural resources concepts, namely biodiversity conservation, sustained yield of multiple uses, ecosystem health, and sustainable development.

The concept of ecosystem management—that knowledge and technology can be skillfully used in taking actions to encourage desired conditions of ecosystems for environ-

TABLE 1. GLOBAL TRENDS IN PEOPLE, LAND, AND RESOURCES PROJECTED FROM 1990 TO 2010 (AFTER POSTEL 1994).

People & Resources: 1990 to 2010

Resource	1990	2010	Total Change	Per Capita Change
Population (million)	5,300	7,000	+33%	
Fish Catch (mil. tons)	85	102	+20%	-10%
Irrigated Land (mil. ha)	237	277	+17%	-12%
Cropland (mil. ha)	1,444	1,516	+5%	-21%
Range/Pasture (mil. ha)	3,402	3,540	+4%	-22%
Forests (mil. ha)	3,413	3,165	-7%	-30%

mental, economic, and social benefits, both now and for future generations—is not entirely new. During the past four decades, foresters, rangeland managers, wildlife ecologists, and fisheries and watershed managers have tried to bring ecosystem concepts into natural resources management (for example see Watt 1968, Van Dyne 1969, Kimmins 1987, Savory 1988, Aplet et al. 1993). In response, several U.S. federal laws enacted during the 1960s and 1970s discussed or alluded to ecosystems in their mandates (Keiter 1994).

But the laws did not anticipate the magnitude of shifts that would occur during the 1970s and 1980s in how people value wildlands and natural resources as our society completed a century-long exodus from rural to increasingly urban settings and lifestyles, and a general philosophical shift from utilitarian to preservation perspectives. So, while the concept of ecosystem management has been around for a while, views on what it comes to mean might be very different than Leopold's ecological-evolutionary perspective (Callicott 1991) or what the scientific and legal work of recent decades might originally have envisioned (Keiter 1994).

BUILDING A COMMON BASE OF UNDERSTANDING

For any concept or approach to land and resource management to work, people need a common understanding of basic principles and a shared vision for expected outcomes. This starts with fundamental definitions. A standard dictionary tells us that ecosystems are complex communities of organisms working together with their environments as integrated units. As an abstract concept this is fine. But it does not provide a tangible meaning of what an ecosystem is, one that nonscientific people can grasp or comprehend. Rowe (1990) says that ecosystems are where organisms live; they are the home places of all living things including humans. This is more tangible.

Ecosystems provide all the resources of life and they receive all the wastes, wanted or not. Some organisms do not need much space or may live as parasites inside the body of another organism; their ecosystems are very small. Other organisms, such as humans, eagles, ponderosa pine, chinook salmon, and wolves, occupy very large areas; their ecosystems are large. Thus, ecosystems are not just abstract, scientific concepts. They are also real places that occur at many geographic scales. The smaller places are nested within the context of the larger places. So, ecosystems form a hierarchy from the smallest to the whole biosphere. There is no single geographic scale that defines what an ecosystem is; the issue at hand determines the appropriate scale. And many people take their identity from the ecosystems in which they live and gain livelihood.

Beyond knowing what ecosystems are, we need a common understanding of how they work if the "new" management concept is to be successful. The writings of Hardin (1985), Kimmins (1987, 1992), and Botkin (1990) are particularly useful to this understanding. I cannot cover all the basic principles of ecosystem function in this brief paper but a few principles will illustrate the point.

All ecosystems are defined or delimited by specific issues, concerns, or resource characteristics. For example, a lake ecosystem is defined by its perimeter and the watershed within which it occurs. A forest ecosystem is delimited by the extent of trees. A "grizzly bear" ecosystem or a migratory salmon ecosystem is defined by the extent of the seasonal movements or home ranges of the animals in question.

All ecosystems have biological and physical limits; without added inputs such as energy, water, new plants or animals, and nutrients, they can only achieve certain kinds of conditions or levels of outputs. For example, growing high yields of corn where a tall-grass prairie used to be requires continual inputs of genetically modified plants and fertilizers.

Ecosystems are complex and interconnected in space and time; every action in an ecosystem causes a sequence of responses, some of which are immediate and on site while others are delayed in time or occur off site (needless to say some of the responses will run counter to desires such as forests with high fuels that result from years of fire suppression).

Ecosystems are constantly changing and evolving in ways that are only partially predictable; we cannot hold ecosystems constant or precisely regulate them to produce constant flows of desired outputs or conditions, whether those be scenery, water, "old-growthedness," wildlife diversity or wood products. Look at time-sequence photos from early expeditions to the West, and recent decades to see vivid examples of this trait.

Ecosystems are renewable because solar energy and photosynthesis allow them to counteract the natural tendencies of things to "wear down" over time; humans can use the renewal capacity of ecosystems in perpetuity if our removals do not deplete long-term productivity. This, of course, is a basic concept behind sustained-yield strategies for rangeland forage, wildlife cropping, and timber management.

How people use ecosystems changes over time and from place to place in response to cultural, economic, and value changes. Thus, the future course of all ecosystems on earth is influenced by human choices whether those choices are to save endangered species, create wilderness areas, or build shopping malls.

As a general "rule-of-thumb," diversity in the physical, biological, cultural and economic conditions of ecosystems is positively correlated with adaptability to stress and change, and options for future ecosystem conditions.

SUSTAINABLE DEVELOPMENT AS A GOAL

Knowing what ecosystems are and how they work is essential but not sufficient to tell us what to manage ecosystems for. Population size and the growing effects of meeting human needs no longer make laissez-faire a responsible land ethic if ever it was. So, we must decide what to do and how to do it. Clawson (1975) posed a question for forest management several decades ago that is also relevant for ecosystem management—Ecosystems for whom and for what? One search for answers that is receiving considerable attention is sustainable development (World Commission on Environment and Development 1987, United Nations 1992). Sustainable development means meeting the needs of present humans without unduly compromising the capacity of future humans to meet their needs.

But what is it exactly that is to be sustained to meet these present and future needs? How? Where? For whom? By whom? For how long before a new goal appears? Sustainable development, nebulous though it may be as a statement of intent, is affirmative about the human enterprise, not retrogressive or static. It recognizes, for example, that improving knowledge and technology or modifying attitudes and ethics can lead to enhanced capacity in the future. But continued degradation of the productive capacity of land might not be fully mitigated by such enhancements. Therefore, maintaining healthy, productive land and natural resources is generally accepted as a precursor to sustainable development.

Developing a common vision for what specifically is to be sustained (or restored or enhanced) in ecosystems at various geographic scales is the challenge we now face. It is a challenge we face as communities of people. It is not just government's job to do this for us as the final arbitrator of conflicting special interests. Nor is it a job solely for ethicists, economists, or scientists. Science does not determine what should be sustained, only what is possible and the likely consequences of alternative choices. Economics illuminates financial and tradeoff costs and benefits of choices, but economics does not tell us what is possible or desired. Neither science nor economics provides a society with its values, and values are what inform people on what is desired and guide their choices. But, then, values do not identify what is possible or what is affordable. Thus, for sustainable development to occur, a community or society as a whole must blend necessary and complementary roles for science, economics, and ethics in finding constructive ways to reconcile competing interests. This is not a social or political adjunct to ecosystem management; it is perhaps more fundamental than sophisticated economic or bio-physical understandings of ecosystem capabilities and responses.

FORESTS, WOOD, AND ENERGY: SOME CHALLENGES IN ECOSYSTEM MANAGEMENT

Forests, because of their many values and uses, not the least of which is that they moderate our atmosphere and hold the soil in place on about 30% of the land surface of the planet, are the focus of much attention as ecosystem-management and sustainable-development concepts evolve. Historical estimates tell us that forests and woodlands covered about 50% of the land surface of the planet around 1700. They now cover about 31%, a 33% decline in 300 years. Forests in the U.S. now cover 32% of the nation's land surface, also a decline of 33% since 1700. About 90% of forest reduction in the U.S. occurred from 1850 to 1910, at the approximate rate of 12,000 acres per day for 70 years running prior to major agricultural improvements and scientific forestry. Population growth during the past 300 years translates these trends into dramatic per capita changes: from 30 hectares of forest per global citizen in 1700 to 0.75 hectare per person today. Corresponding U.S. trends (assuming 10 million human inhabitants of what is now the U.S. in 1700) are 45 hectares per person down to 1.2 hectares today.

Most global forest losses were to agricultural development and other human occupancy. Some of the losses are permanent as long as humans are around; others are more ephemeral. Yet amidst the pessimistic and almost apocalyptic rhetoric about forests, we should realize that these historic losses of forest are not as severe as they might have been. Improvements in agricultural technology, internal combustion engines replacing farm draft animals, fossil fuels replacing wood fuels in developed nations, and the high value of wood as an economic incentive to keep forest lands in forest cover for sustained wood yields have all mitigated even more drastic potential impacts of humans on the world's forests (MacCleery 1993).

Nevertheless, people continue to convert forests to other land uses in developing countries and to draw ever more amounts of wood from the world's forests for fuel, packaging, paper, lumber, and other materials in developed nations. The global picture on forests gains clarity with every passing year: humans use forests for more values and products, more intensely, while the total area of forests to supply those values and uses continues to shrink, compounding the pressure on what is left.

Meanwhile, wood remains one of nature's "wonder materials." It comes from a renewable resource: forest ecosystems and trees. The process of producing the raw material, i.e., growing trees in forests, has environmental benefits that usually exceed those of other uses of the land. And the use of wood in place of alternative materials has environmental as well as aesthetic benefits. Koch (1992), for example, estimates that the energy and atmospheric costs of replacing wood products from 1 billion board feet of timber harvest—the U.S. uses about 45 billion board feet of wood products per year in construction—with products derived from steel, aluminum, concrete, and brick in U.S. home construction might be as much as 700 million gallons of oil consumed and 7.5 million tons of CO_2 produced that would not have occurred had wood been used instead. Replacing domestically produced wood products with similar products from elsewhere also has environmental as well as social costs. Lippke (1992), for example, estimates that 15 times the area of forest must be harvested in Siberia to produce an equivalent amount of wood products from timber harvested in the more productive forests of the Pacific Northwest of the U.S. Furthermore, producing wood products in Siberia is likely to involve local boom and bust economies and cultures and it must be transported from there to here using more fossil fuel.

Clearly, managing forest ecosystems will entail more than deciding where to save primary forests, how many "biological legacies" are needed for forest health, and where to put wilderness areas or tree farms. It certainly must address these concerns. But it must also address the transfer effects of a growing global demand for wood on where and how the supply is going to be produced, what can reasonably be accomplished to reduce demand for raw material through new technology and higher prices for wood, and what effects our combined choices on forest stewardship and wood use might have on local to global economies, environments, and communities. The U.S., with 5% of the world's human population, uses about 33% of the industrial roundwood produced in the world each year and itself only produces about 26% of the total. Thus, U.S. citizens are net importers

of wood from the forests of other nations despite the fact that the U.S. is biologically and economically capable of being a net exporter if it so chooses. The issue of addressing domestic self-sufficiency and global transfer effects of U.S. wood use should therefore be central to U.S. forest-ecosystem-management policy.

Wood production is one important outcome of forest-ecosystem management, but by no means the only important one. Most affluent cultures in the world today acknowledge that some forests should be protected to feature their spiritual and environmental values; that some should be managed intensely to produce the wood products that people need and desire; and that yet others should be managed in ways that balance the protection of environmental values with the production of desired products. Let us refer to these three categories of forests as nature preserves, production forests, and multi-benefit forests.

This is not a new classification of forests by any means. Nor does it imply what kind of land ownership should fall into each category; conceivably any ownership could be in any category. However, it is still not recognized by some people that these three values must complement one another, and each is as important to the full array of for what and whom forest ecosystems should be managed as the others. The task we face is how to obtain optimum overall value from options to have different forests in each kind of use at various points in time. This landscape-scale challenge that often entails coordination across multiple forest ownerships is also fundamental to ecosystem management.

MAKING ECOSYSTEM MANAGEMENT AND SUSTAINABLE DEVELOPMENT DOABLE

Ecosystem management and sustainable development have a similar goal: the sustenance of desired conditions of lands, waters, biota, human communities, and the economic enterprises that depend on healthy, productive land and natural resources. Both also have a similar compelling urgency: the growing human population is putting increasing pressures on the health and productivity of lands, waters, air, and resources, jeopardizing the ability of communities and nations to reach that goal (Silver and DeFries 1990, Postel 1994).

DEFINING ECOSYSTEM MANAGEMENT IN PRACTICAL TERMS

Ecosystem management is variously defined by those who are shaping its course. Beginning with a standard dictionary definition, management is the process of taking skillful actions to produce desired outcomes. If we combine this with the term ecosystem, ecosystem management is the process of seeking to produce (i.e., restore, sustain, or enhance) desired conditions, uses and values of complex communities of organisms that work together with their environments as integrated units.

This integrated systems concept of land and resource management is broader than traditional approaches to the preservation of nature as historically practiced in national parks, wilderness areas, and nature reserves. It is also broader than multiple-use land and resource management as it has been traditionally practiced on American public lands. Certainly it is broader than contemporary intensive agriculture. Ecosystem management emphasizes the integration of ecological, social, and economic factors at different temporal and spatial scales to maintain a diversity of life forms, ecological processes, and human cultures.

Traditional approaches to land or resource preservation attempt to either freeze ecological conditions at a desired state—which is not biologically possible—or allow natural forces to run without human interference—which is appropriate in some cases but not always socially or politically acceptable. Traditional approaches to multiple-use land and resource management tend to focus on sustaining yields of desired resources and uses—such as timber, wildlife, water, minerals, energy, livestock forage, fish, and recreation opportunities—in compatible blends (Gale and Cordray 1991). Conflict among the various resources and their human constituencies is common in multiple-use schemes (Wondolleck 1988). The primary focus of agriculture is to sustain the production of desired crops of plants or animals. This is usually achieved through simplification of ecosystems to guide net primary productivity into the desired crops.

An ecosystem perspective enlarges the focus of land management and resource conservation to whole ecosystems rather than selected parts, outputs, or processes. It does not deny the importance of producing resources needed by people. Nor does it deny the need to protect certain places from certain kinds of human activities or to actively restore natural ecological processes or conditions on human-impacted sites. It seeks a broad focus on sustaining desired ecosystem conditions of diversity, long-term productivity, and resilience, with yields of desired resources and uses being commensurate with the larger goal of sustaining those conditions. This is not what many practicing biologists, foresters, fisheries managers, or range conservationists were taught about management of their featured resource.

HOW ONE U.S. FEDERAL AGENCY EVOLVED TOWARD ECOSYSTEM MANAGEMENT

Some insight into how a transition to ecosystem management can be made comes from looking at how one U.S. Federal agency evolved the concept. The U.S. Department of Agriculture Forest Service, with responsibility for the 191 million acre National Forest System in the U.S., began moving toward ecosystem management during the 1980s, though not explicitly under that name. By the latter part of that decade, the agency recognized four major reasons for formally exploring new perspectives in land and resource management (Overbay 1992):

> People need and want a wider array of uses, values, products, and services from public lands than in the past, especially, but not limited to, the amenity values and environmental services of healthy, diverse lands and waters.
>
> New information and a better understanding of ecological processes highlight the role of biological

diversity as a factor in sustaining the health and productivity of ecosystems and the need for integrated ecological information at various spatial and temporal scales to improve management.

People outside the Forest Service want more direct involvement in the process of making decisions about public resources.

The complexity and uncertainty of natural resources management calls for stronger teamwork between scientists and resource managers than has heretofore been practiced.

In response, the Forest Service chartered a Service-wide set of New Perspectives projects (more than 250 separate projects in all) of research and on-the-ground management demonstrations to do five things:

1. Learn how to better sustain diverse and productive ecological systems.
2. Better integrate the different aspects of land and resources management.
3. Improve the effectiveness of public participation in resource decision making.
4. Continue building partnerships between forest users and forest managers.
5. Strengthen teamwork between researchers and managers.

People from academia, industry, non-governmental conservation organizations, and other state and Federal agencies were enlisted at the outset and throughout to help guide the projects. In summer 1992, as a direct result of experiences with New Perspectives projects and recommendations from a review and evaluation process held in December 1991, the Forest Service announced its intent to develop ecosystem management as a strategic approach for sustaining desired conditions of ecosystem diversity, productivity, and resilience for the multiple uses and values of national forests and grasslands (Robertson 1992). Ecosystem management was proposed as a process for change, not a goal in and of itself. The goals for ecosystem management would come from ecological capabilities of the land together with legal mandates and public needs and aspirations.

The Forest Service has a Congressional mandate to manage lands and resources entrusted to its care under the concepts of multiple use and sustained yield, without impairing the long-term productivity of the land (MUSY 1960). The Forest Service also has a legal mandate to conserve threatened or endangered species (ESA 1973, as amended) and to "provide diversity of plant and animal communities ... to meet overall multiple-use objectives" (NFMA 1976).

The Chief of the Forest Service, therefore, defined ecosystem management within this legal mandate: "an ecological approach will be used to achieve the multiple-use management of the national forests and grasslands by blending the needs of people and environmental values in such a way that the national forests and grasslands represent diverse, healthy, productive, and sustainable ecosystems" (Robertson 1992).

Other federal and state land-management agencies are implementing similar ecosystem-management policies (see especially The Keystone Center 1993 and GAO 1994).

WORKING GUIDELINES FOR ECOSYSTEM MANAGEMENT

Field managers and scientists in both the public and private sectors in the U.S. are now implementing ecosystem management through changes in agency regulations, national program direction, amendments to land-use plans, field projects that carry out the direction in those plans, research programs, and cooperative endeavors with conservation partners in universities and other government agencies and businesses. At this point, principles or working guidelines for ecosystem management have evolved from a variety of theoretical and empirical projects (Salwasser 1991, Robertson 1992, The Keystone Center 1993, GAO 1994, Grumbine 1994, Kaufmann et al. 1994, Salwasser 1994, Wood 1994). These principles and guidelines are open for refinement and are presented here only to show the state of thinking about ecosystem management in the mid-1990s.

Key Steps

1. **State the problem(s)** to be addressed and expected or desired outcomes (social, economic, and environmental) from the anticipated solutions to the problem(s). Rigorous adherence to the scientific method would have problems stated as falsifiable hypotheses. This might be possible in some situations, but in all cases the problems should at least be stated in terms that can guide inventory, analysis, development of alternative solutions, and evaluation of the potential effectiveness of those alternatives. Absent a problem statement, planning and evaluation could wander widely without ever coming to grips with why action is needed in the first place. Furthermore, without clear problem definition the geographic and temporal scales of analysis will not be clear.
2. **Delineate ecosystems** based on biological, physical, economic, and cultural criteria relevant to the specific issues to be addressed. Small-scale issues, such as protection of a patch of native plants or a unique pond or spring, might require delineation of small ecosystems, say a local watershed. Larger-scale issues, however, such as anadromous fish, migratory wildlife, large predators, air quality, or the sustainable flow of forest products to regional industries will require delineation of much larger, regional ecosystems.
3. **Assess and understand ecosystem capabilities** relevant to the problem(s) being addressed and likely responses to management choices and actions. Collect and assemble pertinent data and information on ecological, economic, and social factors important to understanding conditions, trends, and likely responses of the ecosystem(s) in question to management alternatives. This is an integrated analysis that will require an interdisciplinary team of scientists and technicians.

4. **Make informed choices** for goals and actions that address the defined problem(s) and are likely to lead to desired and achievable end results, that is desired future ecological and social conditions and the land-use classes and management actions that will best attain them. Use landscapes as a basic unit for planning and managing lands to meet specific objectives for conditions that will yield both desired future ecological conditions and desired economic and social goals while reconciling conflicts between competing uses and values.
5. **Act, learn, and adapt**. Coordinate strategies for conservation of shared resources. Many natural-resource issues and concerns cross jurisdictional lines. Examples include migratory fish and wildlife, wide-ranging endangered species, long-term regional timber supplies, air quality, and water flows. Regional-scale ecosystems are logical units in which to coordinate land uses and management actions to achieve desired conditions regarding these resources.

Complementary roles for different land tenures, including the legitimate rights of private land holders, may be blended by using existing authorities (Salwasser et al. 1987) or concepts such as Biosphere Reserves (Gregg and McGean 1985) and landscape linkages (Harris and Gallagher 1989).

Process Principles

1. **Get people involved** in all aspects of public-resource decision making so that managers will know their needs and views; so that people will understand their personal responsibilities, what is possible, and what the relative tradeoffs are; and to obtain informed consent on the course of action selected. Use consensus building and negotiated problem solving (Wondolleck 1988) as primary approaches to conflict management. People who are affected by resource management and conservation strategies must feel a strong commitment to being part of the solution.
2. **Work within the scope of natural, social, and economic processes and their variability** that shape landscape, community, and ecosystem conditions. Work within the ecological capabilities and natural processes of different ecosystems and communities of people, maintaining as much diversity as possible and minimizing the energy costs of management to sustain or restore desired ecosystem conditions and functions. Always think about scale effects, both spatial and temporal, at least one scale higher and one scale lower than what you're working on and at least several generations into the future, more and longer if possible. Ecosystems are complex, but models should be relatively simple and management should strive to maintain options.
3. **Integrate information and technology**, such as ecological classifications, inventories, data-management systems, and predictive models, and use them routinely in landscape-scale analyses and conservation strategies. Agencies and affected interest groups and enterprises should contribute to common inventories of the basic conditions of soils, waters, and biota, and share data and other information as appropriate to their missions and property rights. Inventories of biological diversity in the U.S. should build from the foundation of state Heritage Programs (Jenkins 1988) and multi-resource inventories conducted by various state and federal agencies. They should allow prudent choices to be made based on realistic assessments of needs and priorities for investment and protection actions (e.g., Scott et al. 1987, Scott et al. 1991).
4. **Integrate management and research** to continually improve the scientific basis of ecosystem management. Agencies, universities, and affected interest groups and enterprises should cooperate in long-term, interdisciplinary ecosystem research and development. Managers need practical tools and methods for planning and evaluating the expected effects of management options. They also need expanded choices for sustainable harvest and management of resources.
5. **Revitalize conservation education and interpretation**. Agencies, universities, and affected interest groups and enterprises should cooperate in comprehensive programs of interpretation, education, and demonstration of ecosystem management. The result should be a better understanding among the citizenry about the effects of personal actions in sustaining desired ecosystem conditions and better support for the complementary roles played by different agencies and ownerships in overall conservation strategies.
6. **Develop, monitor, and evaluate vital signs of ecosystem health**. Agencies, universities, and affected interest groups and enterprises should cooperate in identifying and monitoring carefully selected indicators of ecosystem health and diversity, including conditions and trends of valued resources. Monitoring should be guided by the use of decision-analysis tools (Maguire 1988, 1991) to ensure that the most vital information is being collected in usable quality and in a timely fashion for the specific purpose of adapting management based on new information (Holling 1978, Walters 1986).

A BIGGER ROLE FOR RESEARCH

Research has a significant role in ecosystem management, including the use of scientific methods in understanding the basic capabilities of different ecosystems; discerning the needs and wants of people; setting ecologically, economically, and socially sound management goals; and designing monitoring systems that will allow for periodic adaptation to new knowledge (National Research Council 1990, Lubchenko et al. 1991). However, scientists are not the only source of information for solutions to difficult political and social choices. For example, there are no unique or scientifically perfect answers for how a balance of goals and practices for ecosystem management should be struck. People's values, preferences, and aspirations are crucial factors in policy making.

The role of science in ecosystem management is to help define what is possible and what is desired: to shed light on how best to attain a desired set of conditions or benefits and help people understand the estimated costs, benefits, and consequences of alternative courses. To fulfill this role effectively, social, biological, and physical sciences must be integrated to reflect the complexity of how ecosystems actually function.

BIOLOGICAL DIVERSITY AND ECOSYSTEM MANAGEMENT

The variety of life—plants, animals, and various microorganisms and fungi—and its many processes in ecosystems determines ecological capabilities. This variety is known by the term biological diversity (The Keystone Center 1991). It includes variation and variability in genes, species, plant and animal communities, and the many processes through which they are all interconnected through space and time.

Biological diversity is a valuable characteristic of ecosystems for ecological, economic, educational, and aesthetic reasons. It is key to the productivity and sustainability of earth's basic life-support systems. It provides numerous current and future resources for human well-being. It provides opportunities for better understanding the myriad of relationships between people and their sources of existence. And it contributes greatly to the beauty and wonder of the world we live in. Biological diversity also has an ethical element: how well we conserve biological diversity demonstrates our respect for other forms of life and our commitment to the well-being of future generations (Leopold 1949).

Scientists do not know all the ecological roles or potential values of biological diversity. Nor do they understand all the processes that keep ecosystems functioning. It is not likely that they ever will. But complete knowledge is not necessary to understand that retaining the natural parts and processes of biodiversity is important for the future health and productivity of all ecosystems (Leopold 1949). How to do this in the face of a growing human population is a major challenge (UNCED 1992).

Incorporating the conservation of biological diversity into ecosystem management requires actions aimed to achieve specific objectives for species, biological communities, and ecosystem conditions. A strategic framework for such actions and objectives has been developed for U.S. federal lands through a national policy dialogue (The Keystone Center 1991). Though the recommendations of the Keystone dialogue are not Federal- agency policy at the current time, they have been adapted here to offer land and resource managers and scientists a framework of specific and measurable goals. To guide on-the-ground actions, the following goals should be reflected in land-use allocations, standards in land and resource management plans, and working guidelines for project activities in specific places.

THREATENED OR ENDANGERED SPECIES

Listed species are the most vulnerable, officially recognized elements of biodiversity. A net removal of species from listed status in an area covered by a plan or program is an ideal goal to consider in ecosystem management. To accomplish this, management must follow approved recovery plans or habitat-conservation plans to protect existing populations and habitats of listed species and restore them if necessary.

VIABLE POPULATIONS OF NATIVE PLANT AND ANIMAL SPECIES

Species whose demographic or habitat trends are negative but not yet to the point of endangerment may be the next most vulnerable elements of biological diversity. Some such species may even be more vulnerable than officially listed species. The ideal goal is to secure the places and functions of native species in regional ecosystems before they reach the point where formal listing as a threatened or endangered species calls into play the extreme measures of protecting species under crisis conditions (Salwasser 1991).

To sustain viable numbers of native species habitats, human activities and artifacts, and wild populations of plants and animals must be managed to assure that they are numerous and well-distributed throughout their geographic ranges. This requires a combination of actions to protect, restore, and enhance sufficient kinds, amounts, qualities and distributions of sub-populations and habitats. Especially important in achieving population viability is the perpetuation of multiple, interconnected, demographically resilient local populations; the characteristic genetic variation of the entire species; and the full range of the species' roles in ecological processes. Principles of conservation biology (Soule and Wilcox 1980, Soule 1986, Soule 1987, Primack 1993, Meffe and Carroll 1994) are useful in this task.

NATIVE BIOLOGICAL COMMUNITIES AND ECOSYSTEMS

Rare, unique, or sensitive biological communities or successional stages (often highly productive sites, riparian areas, wetlands, and mature or old-growth successional stages) are likely to be vulnerable elements of biological diversity in certain landscapes. Lands, human activities and artifacts, and wildlife habitats must be managed to assure that a network of representative, native biological communities and developmental stages of ecosystems are maintained across the landscape (Noss and Cooperrider 1994). This may involve ecological restoration in some cases.

Especially important are communities or assemblages of species that are rare or imperiled in the region or nation (Jenkins 1988). The matrix conditions of a landscape should provide essential resources for all species to the degree this is possible, including conditions needed for normal movement of plants and animals throughout the landscape and for the full range of ecological processes characteristic to the area. Where this is not possible, a specific network of sites and connections between them may be needed. The sites and connections must be sufficiently large and diverse to accomplish their intended purposes.

STRUCTURAL DIVERSITY

Natural elements of structural diversity such as snags, caves, fallen trees, and seeps provide habitats for many species that would not occur in an area without them. These elements can be jeopardized by intensive human uses such as fuelwood gathering, heavy livestock grazing, clearcutting, and water diversions. Elements of structural diversity should be perpetuated in qualities, amounts and distributions within patches, and across landscapes to assure their roles in sustaining desired conditions of ecosystem diversity, productivity, and resilience from site to regional geographic scales (Franklin 1988).

GENETIC DIVERSITY

The genetic variation of intensively managed wild plant and animal populations can decline if sufficient attention is not paid to the effects of human selection for various traits. Species and habitats, especially those of high commercial value and thus intensively harvested, should be managed to sustain natural levels of genetic variation within and among populations, and the genetic integrity of representative and extreme populations (Ledig 1986, Millar 1987).

RESOURCES NEEDED FOR HUMAN WELL-BEING

Human well-being ultimately depends on natural resources (Chappelle and Webster 1992). People will obtain those resources from somewhere. The key is to produce them in ways that do not lead to undesired environmental effects at local, regional, or global scales. If resources can be produced in some ways and in some places that allow human pressures on biological diversity in other places to be reduced, then resource-production zones can have a positive and critical overall effect on biodiversity conservation. High-productivity sites such as flat ground with deep loamy soils, and featured species such as pines, firs, oaks, elk, and trout should, thus, be managed with state-of-the-art efficiency to sustain the production of resources needed by people, thereby meeting human needs for natural resources with minimal impacts on more fragile sites and more sensitive species.

ECOSYSTEM INTEGRITY—SOILS, WATERS, BIOTA, AND ECOLOGICAL PROCESSES

Any human activity has some effect on lands, waters, or biota. The removal of biomass or the introduction of toxics, exotic species, or nutrients has some effect on the composition, structure, and function of the local ecosystem. Ideally, these effects can be minimized through sensitivity to ecosystem integrity. Actions that are known to degrade site conditions or long-term ecosystem diversity, productivity, or resilience should be avoided if possible or mitigated promptly when not. The natural restorative powers of ecosystems should be employed in resource-management activities. Consider the kinds, amounts, and distribution of living and dead organic matter to be left in ecosystems for long-term diversity, productivity, and resilience following resource harvest along with how much biotic production of the system is to be removed for human uses. This is essentially a principle of treating the ecosystem as "capital" and the production as "interest" (Rowe 1992).

DEGRADED ECOSYSTEMS

Biological communities, waters, and soils that have been damaged by natural events or past human actions should be placed under restoration and renewal programs, embracing the concepts and methods of restoration ecology and management (Bonnicksen 1988, Cairns 1986, Jordan et al. 1987, Jordan 1988).

There is more to the conservation of biological diversity in ecosystem management than identified in this framework but these actions are a reasonable start on a comprehensive conservation program.

CLOSING THOUGHTS

The need for ecosystem perspectives in land and resource management is forcing people to try some new and some old thinking. Five themes characterize this integrated thinking:

- Sustain diverse and productive ecological systems.
- Integrate the different aspects of land and resource management, research and conservation.
- Improve the effectiveness of public participation in resource decision making.
- Build partnerships between resource users and resource managers.
- Strengthen teamwork between researchers and resource managers.

Sustaining desired ecological, economic, and social conditions in wildland ecosystems that are managed by different owners for multiple purposes is a big challenge. But it is not an impossible task if people realize that no single objective can dominate ecosystem management at all geographic scales or even at the same site for all times. Success in sustaining desired ecosystem conditions will depend on having scientifically sound, economically feasible and socially acceptable strategies for achieving combinations of ecological and social goals.

For example, it will depend on meeting specific objectives for viability of native species and biological communities such as spotted owls, grizzly bears, elk, and tall-grass prairies. It will depend on meeting specific objectives for the characteristics of landscapes such as habitat conditions that are aesthetically pleasing and allow for free movement of plants and animals over time. It will depend on coordination among people responsible for species or resources that transcend administrative boundaries such as the spotted owl, large predators, eagles, migratory birds and mammals, and timber and mineral resources. It will depend on practical management standards for the desired characteristics of distinct patches in a landscape, such as diversity of species, structures, and functions provided by snags, fallen trees, riparian areas, and prairie barrens. It will also depend on better integration of research with management, especially in monitoring conditions pertinent to objectives.

These and other actions to sustain desired ecosystem conditions are changing traditional approaches to intensive resource production, multiple-use management, and nature preservation. Some of these changes might result in higher management costs, or to less access to resources for people who have high dependencies on those resources for subsistence or economic well-being. On the other hand, they might also result in lower management costs or in resource management being carried out in areas previously considered to be "off-limits" to human use of resources.

Only site-specific assessments can show what the nature of the changes might be. In any case, changes in public land uses are often difficult to establish and implement both politically and logistically. But they are tractable if people decide they are willing to make them. This will require dedicated professional leadership and commitment, an eagerness to share in the excitement and potential of ecosystem management with publics, and a stable social setting that supports long-term common good.

The learning process for ecosystem management is far from complete. In fact, ecosystem management as a process for sustaining diverse, healthy, and productive land has just begun. To date, we have some principles, guidelines, tools, research and development programs, and several hundred practical demonstrations to draw from. These will expand in our continuing pursuit of new knowledge and technologies.

An ecosystem perspective on sustaining desired conditions of wildland diversity and productivity is an approach many state and federal land-management agencies are pursuing at this time. But it will be insufficient by itself to sustain a harmonious relationship between people, land, and resources. Regardless of how well ecosystem management works on the ground, other actions will be needed to bring people and land into a better harmony.

NEEDED: A GLOBALLY RESPONSIBLE CONSERVATION ETHIC

Foremost among these actions, Americans must become more conservative in how they (we) produce, use, and dispose of natural-resource products. American behaviors regarding consumption and waste of resources are major forces of change in the global ecosystem (Silver and DeFries 1990, Postel 1994). Americans need to renew their conservation ethic to bring balance to the complementary roles of managing ecosystems, producing resources, and conserving resources (Postel and Ryan 1991). A recent public-opinion survey found that, despite an economic recession, the American public is prepared to make the commitments such an ethic entails (The Roper Organization 1992).

Sustaining diverse, productive, and resilient ecosystems in the U.S. is important. But it must be balanced by a commensurate change in how and where Americans get and dispose of their resources. The potential off-site effects of protecting ecosystems in one place, such as old-growth forests or wildlife refuges in certain regions of the U.S., while continuing profligate use of resources that are produced in other places, such as oil from the Middle East or timber from Canada, are not well understood by many people. All of this planet's ecosystems are ultimately interconnected. The potential for interregional and international transfers of the economic, ecological, or social effects of where resources are produced and where they are used highlight the veracity of Garrett Hardin's (1985) comment that "it is not possible to do only one thing in an ecosystem." U.S. resource policy needs to start paying as much attention to the off-site effects of actions or inactions we take to protect nature or produce resources as we do to the on-site effects. And we need to think more about long-term dynamics in ecosystems. Things do not stay fixed or in the same place over time. Again we turn to Garrett Hardin (1985). His key ecological question, "and then what?" is a clue to how citizens and ecosystem managers must think when they think they are closing in on a simple solution to a complex problem.

NEEDED: A NEW MODEL FOR CONSERVATION SCIENCE

Finally, to shape ecosystem perspectives on land and resource management, especially on the linkages between ecological, economic, and social factors that an ecosystem view implies, social, biological, and physical sciences must become better integrated (National Research Council 1990, Lubchenko et al. 1991). We will not learn how to sustain diverse, healthy, and productive ecosystems if we continue to pursue only traditional disciplinary sciences and education whether they be oriented to biological, physical, or social goals.

Ecosystem management has the capability to bring forth a new model for developing the scientific basis of conservation: interdisciplinary teams of researchers working hand-in-hand with managers, educators, and citizens to address both short- and long-term dynamics in the many dimensions of relationships between people and the land. The working principles for such a model, known as adaptive management, have been evolving for nearly 20 years (Holling 1978, Walters 1986). It is time to make the adaptive-management model standard procedure for sustaining diverse, healthy, and productive ecosystems.

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SESSION 1. FOUR KEY QUESTIONS

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1. WHAT IS ECOSYSTEM MANAGEMENT?

2. WHAT ARE THE TECHNICAL, NATURAL-SCIENTIFIC PROBLEMS OF IMPLEMENTING ECOSYSTEM MANAGEMENT ON THE GROUND?

3. WHAT SOCIAL AND POLITICAL MECHANISMS WILL BRING DISPARATE GROUPS TOGETHER IN AGREEMENT ON MANAGEMENT GOALS?

4. WHAT ARE THE LEGAL AND ADMINISTRATIVE PROBLEMS SURROUNDING THE ISSUES OF MULTIPLE LAND OWNERSHIP, FEDERAL, STATE, AND PRIVATE?

Learning To Play By Nature's Rules

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Abstract

Many countries are applying new, ecosystem-based approaches in management of lands and natural resources. In the United States, policies and practices of "ecosystem management" are significantly changing management of public forests and rangelands. The changes originate from public dissatisfaction with land-management planning and practices, and from growing concern for the health, diversity, and sustainability of forest and rangeland ecosystems. Ecosystem management emphasizes ecological processes and strives to work with, rather than against, the natural dynamics that shape and sustain ecological systems. It takes a big-picture perspective on land and resources management, and furthers understanding of ecological systems and management effects through an adaptive-management approach. Ecosystem management recognizes people as integral components of ecosystems, and strives to be responsive to the lives, livelihoods, and cultural values of people who have a stake in the outcome of management. Ecosystem management calls for better understanding of how ecosystems work, innovative management approaches, and a generous dose of humility.

INTRODUCTION

Many countries are formulating new policies for managing lands and natural resources. In the United States the movement began in the USDA Forest Service with an initiative, called "New Perspectives," that quickly evolved into the policies now espoused by numerous agencies as "Ecosystem Management" (Kessler et al. 1992, Kessler and Salwasser 1995). In Canada, ecologically sound and socially acceptable management is a key theme of the Canadian Forests Accord adopted by government, industry, aboriginal groups, and other sectors in 1992 (Canadian Council of Forest Ministers 1992). Similar developments may be observed in Europe, India, and elsewhere (Government of India 1988, National Board of Forestry Sweden 1990).

Although the details and terminology may vary, everywhere the new policies reflect a common purpose. That purpose is to sustain healthy and productive ecosystems that meet the diverse economic, cultural, and ecological needs of people today while not diminishing the ability of future generations to meet their own needs (Maini 1992).

DEALING WITH COMPLEXITY

Why is it that in so many places, people are re-thinking the management of their lands and natural resources? The simple answer is this: forest and rangeland management has gotten so complex today that problems can no longer be resolved by the "fixes" offered by traditional approaches. Issues of human health, economic health, political stability, and social equity are inextricably linked with the ecologically sound and sustainable management of lands and natural resources (Kaplan 1994).

But that simple answer is somewhat misleading. The truth is that management of forests and rangelands has always been an extremely complex proposition, if for no other reason than that these ecosystems are inherently complex and full of uncertainty. Add to that the complications pertaining to people's relationships with lands and resources, and management becomes a "messy" proposition indeed.

In managing lands for production purposes, our approach has been to dismiss or ignore these complexities; to treat them as "complications" that exist outside the purview of science-based management. This approach reflects the mechanistic view of nature that has shaped science and management in the natural-resources disciplines (Botkin 1990). For professionals in forestry, wildlife management, fisheries, and rangeland management, a key role has been to identify limitations on production and to try to remove these limitations through science and technology (Behan 1990). This production-oriented view explains why such terms as timber volume, wildlife habitat capability, animal-unit-months of grazing, recreation user-days, and other measures of potential "outputs" have dominated the lexicons of the natural-resources disciplines. It also accounts for the emphasis on resource stocks and flows, and the lack of attention to the states and conditions of lands and resources (Brooks and Grant 1992).

The habit of over-simplifying land and resources relationships, and of trying to treat problems with technical fixes, has gotten resource managers into serious difficulties in recent years. Indeed, it is these difficulties that have triggered

the search for new and more effective approaches for dealing with lands, natural resources, and people; the approaches we now refer to as ecosystem management. Some of the difficulties are of socio-cultural origins, deriving from people's relationships to lands, resources, and one another. Others are of ecological origins, deriving from the treatment of forests and rangelands more like croplands than as complex ecological systems (National Research Council 1990).

PEOPLE'S RELATIONSHIPS TO LAND AND RESOURCES

The views and values that societies have for lands and natural resources are often quite different, and more diverse, than those emphasized in the resource-management disciplines. In the multiple-use approach that has dominated public-land management for several decades, forests and rangelands are viewed primarily as places capable of yielding outputs to support the resource-dependent industries such as timber, livestock production, fisheries, and outdoor recreation (Behan 1990). People's linkages to the land, rather than being direct, are seen through the resource-based industries that make available products, jobs, and related income. As important as these relationships are, they do not fully represent the complex connections of people to lands and natural resources. Relationships also include people's subsistence and recreational activities, their lifestyles and livelihoods, their historical roots, their family and community traditions, their environmental ethics; in short, their sense of self and of place (Kessler 1994).

The USDA Forest Service learned the shortcomings of the output-driven approach in painful fashion. Following passage of the National Forest Management Act (1976), the agency began an ambitious effort to develop comprehensive land and resource management plans for all the national forests and grasslands (Wilkinson and Anderson 1987). The process featured a strong public involvement component, as required by the National Environmental Policy Act (1969). Forest Service planners tried to represent public concerns by generalizing them as "competing interests" in the multiple uses of national forest lands (Congressional Research Service 1993).

When the plans were completed, many of them were rejected by the people who supposedly had provided input into their development. What went wrong? Although a great many issues were raised in plan appeals, throughout them ran a common thread. While emphasizing output yields from the forests and rangelands, the plans neglected many of the things that people really cared about. People's concerns tend to be highly personal in nature, having to do with the condition of specific places within a national forest or grassland. At stake are the settings, sites, and experiences that have special meaning to individuals, families, and communities.

An ecosystem-management approach rejects the homogeneous approach that seeks to manage forests and rangelands everywhere for the same basic mix of resource outputs. Instead, each forest or rangeland is recognized as a unique setting ecologically, culturally, and economically. Management must be tailored for each situation in partnership with the people who have a stake in the outcome. Ecosystem management requires an understanding of how people's lives, livelihoods,and cultural identities are woven within the fabric of a given ecosystem. Such understandings allow development of management approaches that work with, rather than against, the cultural values and economic interests of people who comprise the community of interests for that forest or rangeland area.

ECOSYSTEM HEALTH AND SUSTAINABILITY

The scientific community as well is questioning the mechanistic views that have shaped natural-resources management and research. In light of serious ecological problems, there is a growing voice for approaches that recognize the inherent complexity and uncertainty of forest and rangeland ecosystems.

The ideal of forest management, as portrayed in magazine ads of previous decades, featured fully-stocked stands of vigorous young trees, neatly arranged within beautifully regulated forest landscapes. Typically, these images included dams, reservoirs, and other images of human engineering and the "taming" of nature. The ideal of the managed forest was clean and waste-free, with all its productive capacity directed to human uses. Fundamental to this vision was the notion of humans in control of nature. It turns out, however, that such picture-perfect forest management exists only in magazine ads, or in exceptional situations where massive inputs and expense make such a picture possible (for example, on intensively managed private lands). Elsewhere, for example on the public lands, the picture cannot be realized because things happen to disrupt even the most sophisticated plans and projections. These disruptions include fires, floods, hurricanes, windstorms, insect outbreaks, and other natural catastrophes.

Increasingly, we realize that the real catastrophe is not the processes themselves, but rather the failure of land-use planning and management to consider these dynamic processes and events as integral parts of natural ecosystems and landscapes (Botkin 1990). The rationale behind the massive fire, flood, and pest-control programs of the current century was that these destructive forces could, and should, be controlled or eliminated. In hindsight, however, control programs do not really eliminate these disturbances. Rather, they tend to lengthen the period between events, so that when disturbances do occur they are more difficult to control and are more severe in their effects.

Why have we treated these important dynamics as externalities instead of building knowledge of them into our planning and management? It is largely a problem of scale. Resource planning and management have tended to focus at the level of forest stands and rangeland sites; scales where we felt that predictability and control were more attainable. Those scales alone, however, provide a distorted picture of ecological pattern and process (Turner et al. 1993).

A different understanding emerges when forests and rangelands are viewed from a big-picture perspective. What appear to be destructive events from a site or stand perspective may be seen instead as ecologically vital processes when viewed from the larger perspective. These disturbances com-

prise the renewal processes by which nature sustains vigor, resilience, and adaptability of the systems in the long term (Society of American Foresters 1993). Ecosystem management assumes that there is some range of conditions that defines an ecosystem's ecological sustainability; and that for long periods ecosystems have and can maintain themselves within that range. Being within this range means that biological diversity is intact and the system is resilient to short-term stresses; in other words, the system is basically "healthy."

There is growing evidence that many North American ecosystems have drifted outside the range of ecological sustainability, as indicated by degraded rangelands and the "forest health crises" that are getting so much attention today (U.S. General Accounting Office 1988, National Research Council 1994). The Blue Mountains of Oregon and Washington, for example, are experiencing a forest health crisis of immense proportions. The changes are believed to have been triggered by exclusion of fire from the system, followed by additional stresses from drought, insects, and diseases (Wickman 1992). Understanding these dynamics, and how the health of the systems might be restored, are major aspects of the ecosystem management approach underway in the Blue Mountains (Jensen and Bourgeron 1993).

BUILDING THE KNOWLEDGE BASE

The basic idea of ecosystem management is simple: we must seek to understand the processes by which nature sustains a particular ecosystem in a healthy, diverse, and productive condition. And, we must design our management approaches to work with, rather than against, these natural processes (Jensen and Everett 1993). Easier said than done, however, given that our understanding of ecosystem dynamics is in its infancy. How can we implement ecosystem management when the research has not been done to support it?

This is a troublesome question, but in fact managers cannot delay acting until scientists complete a wide array of studies on ecosystem structure and dynamics. What's required instead is a new way of looking at land-use management: as operational-scale experiments for testing our assumptions and hypotheses about ecosystem response to management. This concept, termed adaptive management, views the implementation of any land-use plan as an important opportunity to "learn by doing," for the purpose of continually testing, adjusting, and refining management to meet desired outcomes (Walters and Holling 1990). Adaptive management calls for new relationships between scientists and managers. Traditionally working in separate spheres and often with divergent agendas, the two must collaborate closely so that we can learn from the management experience as well as from experiments.

PEOPLE AS PART OF ECOSYSTEMS

One of the key concepts of ecosystem management is the recognition that ecological concerns and human concerns are closely intertwined, and cannot meaningfully be addressed in isolation from one another. This theme is reflected in the new synthesis disciplines that have emerged in recent years, such as conservation biology, landscape ecology, restoration ecology, and ecological economics. Increasingly, the old arguments about "what's right for people" versus "what's right for nature" are seen to be a false dichotomy. Health and prosperity of human societies depend on the health, productivity, and sustainability of the ecosystems that provide needed products and services. The old debates distract us from the real challenge, which is to reconcile ecology and economics.

A key assumption of the industrial age has been that economic growth, the key to human prosperity, is limited only by the ability of science and technology to make the land yield its resources to supply human needs. The belief that humans can "tinker with nature and improve it" (Botkin 1990) has been a prominent theme in the sciences supporting agriculture and natural-resources management. Increasingly, however, there is recognition that resource supplies, after all, may not pose the most important limitations on future growth. Instead, the limits may be the ability of Earth's ecological systems to tolerate the stresses being placed upon them by human activities. Although as yet unexplained scientifically, the widespread decline of amphibian species may be a sort of "coal miner's canary" that warns of a deteriorating global environment.

Given these environmental urgencies, we can no longer treat as separate concerns the development of resources, protection of the environment, and the social and economic wellbeing of human communities. Ecosystem management recognizes all these concerns as within the purview of land and resources management, and attempts to reconcile them in a manner consistent with the finite and fragile nature of ecological systems.

SUSTAINING FORESTS AND PEOPLE IN INDIA: AN EXAMPLE

These proceedings include several examples of how ecosystem management is being implemented in forest and rangeland ecosystems of the United States. Therefore, I will close with an example from afar: forests and rural people in India.

India's new forest policy of 1988 reflected a remarkable turnabout in thinking that had prevailed in Indian forest management since early colonial days (Government of India 1988). It was a policy of no new plantations, and further called for the protection and restoration of India's remaining native forests. "The principal aim of Forest Policy must be to ensure environmental stability and maintenance of ecological balance including atmospheric equilibrium which are vital for sustenance of all lifeforms, human, animal, and plant. The derivation of direct economic benefit must be subordinated to this principal aim" (Government of India 1988, Section 2.2).

This move took many outsiders by surprise. A common response was "how can a poor country like India afford such a policy?" A closer look revealed that India's move, rather than being a luxury, was something it could ill afford not to do. One of India's greatest problems is providing for the day-

to-day survival needs of rural peoples, many of whom live in the remaining forest areas. People have for countless generations obtained their food, fodder, fuelwood, building materials, medicines, and other materials in India's forests. For people who have the cultural knowledge and traditional skills, diverse native forests are a veritable larder that makes survival possible. Although plantations provide jobs and income for some, their ability to support tribal peoples is limited. And hence India's emphasis on sustaining the native forests that are the foundation of people's livelihoods, cultural histories, and community identities.

IN CONCLUSION

The changing approaches to land and resources management, in the U.S. and elsewhere, reflect the growing perception that we are fast reaching the limits of our life-support systems. Whereas "growth" has been the by-word of resources management, "sustainability" is gaining in prominence and urgency. Society's priorities appear to be shifting from economic growth to sustainable economies, from increased resource production to more effective resource production and use, and from sustained yields to sustainable ecological systems.

Ecosystem-management thinking leads us away from policies and practices aimed at "outsmarting nature" to bring ecosystems under human control. Instead, ecosystem management emphasizes the need to understand and appreciate how nature works to sustain healthy and productive systems, so that we can tailor management to work with, rather than against, those processes.

Does ecosystem management require better science and technology? Of course. But that science and technology must be tempered by a generous dose of humility. We must learn to play by nature's rules.

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Object or Context?

An Ecologist's View of Ecosystem Management

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Abstract

There is a need to recognize a duality of object and context perspectives on ecosystems, and a need to synthesize the two in a way which clearly identifies the distinctions and links between them. This paper proposes a new terminology of spatially-fixed atoms, diffuse entities, and molecules to represent ecological entities; and it argues the need for identifying the processes linking them.

Ecosystem management will require development of simple, mechanistic models of local ecosystem dynamics which incorporate basic successional dynamics, disturbance response, and management response. It will require development of statistical, predictive models of ecosystem distribution on the landscape. And it will require development of simple, spatial integration algorithms linked to a spatially explicit database in a GIS.

INTRODUCTION

Ecosystem management has emerged as a critical issue in land and resource management. While ecosystem management encompasses a broad range of perspectives and disciplines, I will allow other scientists and managers to address the breadth of issues concerned, and restrict my remarks to the "ecology" in ecosystem management. Specifically, I will first comment on the ecological basis of resource and land management in the recent past and present, and then discuss a range of problems and controversies inherent in developing of the concept of ecosystem management. Finally, I will follow with some recommendations concerning helpful concepts and tools for practical ecosystem management. It must be remembered that these recommendations are the views of an ecologist, rather than an ecosystem-management specialist, and are necessarily too narrow to address all the issues of ecosystem management. They reflect, however, the views of a scientist with strong interests in both ecological theory and the design of ecological-management systems.

Ecosystem management has been defined by a broad range of individuals and organizations, with emphases ranging from preservation (Grumbine 1994), to the importance of policy and broader social concerns (Slocombe 1993), to utilization (USDA 1992, USDI 1993). It is not my purpose here to review those definitions comprehensively, but rather to comment on the general nature of these definitions. As an example, let us use a simple definition.

> Management of ecological entities and processes to achieve and sustain desirable ecosystem structure, composition, and function, while providing, to the extent possible, those commodities and services desired by the public.

While we could argue the merits and shortcomings of the above definition, it is the abstract and general nature of the definition I wish to call attention to. While the general intent of the definition is clear, the specific implications of the definition are much less clear. By analogy, let us look at the following definition of cooking:

> Combining food items in a specified order and manner, generally applying heat of a specified duration and intensity, to produce an aggregate that is pleasing to the palate and the eye, and is highly nutritious.

Again, we could argue the merits of this definition of cooking, but that wouldn't help put food on the table, or by analogy, put ecosystem management into practice. What we need are some recipes. While we are all aware of the limitations and dangers of "cookbook solutions" to ecological problems, we need some place to start to learn the art and science of ecosystem management. Once we have a little experience, we can dispense with the cookbook, and design solutions to specific problems or opportunities.

ECOLOGICAL CONTENT OF RESOURCE MANAGEMENT

Foresters, range managers, wildlife biologists, and other natural-resources managers all recognize that we have always had a great deal of ecological theory and insight underlying the principles and practices of natural-resources management. In the past, however, this scientific basis has largely been developed from the disciplines of ecophysiology (study of the relationship between organisms and their environment) and population biology (study of population change as a function of time and resources available). These disciplines were highly applicable to the paradigm of sustained yield-multiple use, as they formed the scientific basis for maximization of production efficiency which was clearly in line with the objectives of sustained yield. This emphasis on production efficiency, however, has led to a great simplification of ecosystem structure and function, which is now generally recognized as undesirable (Roberts 1991).

In ecosystem management, the disciplines of ecophysiology and population biology will remain cornerstones of the scientific basis of resource or wildland management, but must be augmented by additional disciplines to achieve a more balanced approach. Specifically, in the future we must emphasize the roles of:

- ecosystem ecology—study of the components and processes of ecosystem function
- landscape ecology—study of the importance of spatial juxtaposition and patterning of ecosystems on ecological processes
- conservation biology—study of the maintenance of biodiversity and minimal viable populations of all native species.

In contrast to sustained-yield multiple use, the emphasis must be on achieving and sustaining diverse and complex ecosystem structure and function in the broadest sense (Roberts 1991).

A TALE OF TWO PERSPECTIVES

Adding additional ecological disciplines to the mix already present will greatly increase the ecological content of land and resource management. However, it will also add complexity to the way land and resources are viewed. Different ecological disciplines (and ecologists) see the world in different ways (Allen and Hoekstra 1992, Rowe and Barnes 1994). While undoubtedly a range of viewpoints exists among ecologists, I believe that there are two fundamentally different ways of viewing ecosystems: object and context.

From the object perspective:

- Ecosystems are tangible, identifiable, mappable entities with boundaries discernible by objective criteria.
- The object of management is the ecosystem itself.

Accordingly, the procedure for ecosystem management is as follows:

1. Classify and map ecosystems.
2. Define desired future conditions for each ecosystem.
3. Determine and implement the management activities required to achieve the desired future condition.

The object perspective is described in detail in a series of papers by Barnes and colleagues (Barnes et al. 1982, Barnes 1983, Pregitzer and Barnes 1984, Albert et al. 1986, Barnes 1993) who describe the concept as "the landscape ecosystem approach."

The context perspective emphasizes the following:

- Every ecological process has its own spatial and temporal scales.
- Every ecological entity perceives its environment at its own spatial and temporal scale.
- There are no ecosystem boundaries appropriate for all or even many ecological processes or entities.
- The object of management is the ecological entity or process, and the ecosystem forms the context of this management.

From this perspective, the procedure for management is:

1. Identify the appropriate spatial and temporal scales for a given entity or process.
2. Identify the role a given entity or process plays in the ecosystem, and the other entities or processes influenced by changes in this entity or process.
3. Determine and implement the management activities required to achieve the desired change while mitigating or compensating for undesirable concomitant changes in the ecosystem.

The context approach is best described by Allen and colleagues (Allen and Hoekstra 1992, O'Neill et al. 1986). While the two perspectives are clearly different, both are means to implementing ecosystem management, and the choice between them is not always clear.

OBJECT PERSPECTIVE

If we accept the object perspective as most appropriate for implementing ecosystem management, a number of issues emerge. First, there is no agreement on the correct or most appropriate way to classify ecosystems. Ecosystems are complex, dynamic, multi-dimensional entities and the number of possible ways to classify and map them is nearly infinite.

A common suggestion and approach is to use watershed boundaries as ecosystem boundaries. This approach has the advantage that the boundaries are generally identifiable on objective criteria both in the field and on maps or digital representations of the landscape. Watersheds have also served as the system entities for "ecosystems" for a large number of scientific studies of nutrient cycling and ecosystem function, as well as for studies of stream ecology and riparian-area analysis. Unfortunately, watershed boundaries are really only appropriate for ecological issues dominated by hydrological processes, or perhaps fire behavior. Free-ranging terrestrial

organisms certainly pay little attention to watershed boundaries, and may cross into and out of these watersheds daily, seasonally, or on longer time scales. Even for sessile terrestrial organisms, such as plants, watershed boundaries are often inappropriate. Forest vegetation in the headlands of one watershed is often more similar to forest vegetation in the headlands of adjacent watersheds than to other vegetation types within the same watershed. Clearly, these forests are more connected to other forests by such ecological processes as propagule dispersal, pollination, pathogen dispersal, and herbivory. Delimiting the ecosystems along watershed boundaries is clearly only appropriate for a subset of the issues we are concerned with, and may make other ecological issues more complex, rather than more manageable.

Another common approach is to delimit areas homogeneous with respect to geology, geomorphology, soil, potential natural vegetation, and current vegetation. Barnes and colleagues (see above) advocate a holistic, multifactor approach based essentially on work done in Canada (Hills 1952, 1960, 1977) and Germany (Barnes 1984). This approach is extremely intensive and data demanding, however, and is likely to be infeasible for much of the public lands in the U.S. due to lack of data and effort. In addition, given these basic homogeneous units, there is no obvious way to aggregate them into higher-order, larger geographic units. A proposal for a national or regional hierarchical classification of ecosystems has been developed by Avers et al. (1994) and Bailey (1980). This system is top-down rather than bottom-up, and proceeds primarily by subdivision of climatic and geomorphic units. The problem, however, is that any criterion of aggregation will work for some subset of ecological processes, and obfuscate others. This point is elaborated below in the discussion of the context perspective. Finally, another suggestion is to use critical habitat for specific animal species as the ecosystem boundary. Examples include grizzly bears or elk in the Greater Yellowstone Ecosystem. The assertion is that free-ranging animal species don't observe political boundaries, and that political boundaries often divide what appear to be "natural" ecosystem boundaries observed by animals. One problem with this definition is that different animal species would cause the boundaries to be drawn differently. If we employed neotropical migrant bird species as our object of concern, much of the western hemisphere would be included in a single ecosystem. Another significant problem is that ecosystems bounded by such a definition are frequently so large that they offer no site-specific management guidelines. If all decisions about the Greater Yellowstone Ecosystem require considering all areas included by that definition, then we have lost the local focus required by many ecosystem-management issues.

This last point anticipates a more general problem. No matter whether we use watersheds, homogeneous units, or animal home ranges, there is no single appropriate size for ecosystems. If the units are too small, as is likely with the homogeneous-unit definition, then we lose the context required for effective ecosystem management. Many of the problems of the previous multiple-use sustained-yield paradigm have been the emphasis on local conditions without consideration for the larger landscape consequences of local site management. If, however, the units are too large, then too much variability is included within units, and the predictive or prescriptive power of the units is greatly reduced. In general, all units are simultaneously too small and too large, depending on the specific issue at hand.

Finally, there is the problem of defining "desired future condition." Most definitions emphasize that areas should be "natural" in some sense, but such determinations are problematic. What factors or entities do we include or exclude on what basis? If we recognize that humans are a significant component of the ecosystem, then what level of technology do we include as part of a "natural" human society? Recent archeological evidence and ecological research makes clear that humans have been significantly modifying ecosystems in western North America with fire for a long period of time (Arno 1985). In many areas we have no idea what ecosystems would have looked like in the absence of human modification. We may simply settle upon "pre-European" vegetation as the desired condition, but these ecosystems have been changing in response to environmental dynamics for thousands of years (Covington et al. 1994). Why choose a certain century? Much of the forest we now call "old-growth" established during the Little Ice Age, when the climate was significantly colder and wetter than at present. Should we choose to maintain ecosystems that are out of equilibrium with current and future conditions?

Morgan et al. (1994) and Risbrudt[1] present an elegant argument that the basis for determining "desired future condition" should be the "historic range of variability," where the definition of historic emphasizes the multiple time scales on which ecosystem processes operate. The historic range of variability at least puts bounds on the range of desired future conditions, if it does not point to a specific condition. However, as Morgan et al. (1994) note, it is foreseeable that society may choose a desired future condition outside of the historic range for a variety of social, economic, or political reasons.

I would argue that there is no such thing as a desired future condition for dynamic entities subject to inherent dynamic processes and disturbances. Rather than speak of a desired future condition, we should speak of a desired future trajectory or dynamic for specific elements of the ecosystem. We should speak of a desired future dynamic mosaic for landscapes. We have to recognize the dynamic tendencies of ecosystems, and incorporate disturbance as a management tool.

CONTEXT PERSPECTIVE

The context perspective is also fraught with difficulties. Proponents of the context perspective maintain that each ecological entity or process operates at its own spatial and temporal scale, and that general ecosystem boundaries cannot be drawn (Allen and Hoekstra 1992). However, without boundaries ecosystems are probably unmanageable by existing land-management agencies; for practical purposes boundaries must be drawn. Given a set of boundaries, the context perspective requires us to manage multiple spatial and temporal scales simultaneously, which is obviously extremely difficult. In addition, the context perspective emphasizes

[1] See Risbrudt, this volume.

ecosystem processes, rather than states or conditions, and processes are much more difficult to measure and monitor than are states or conditions (Roberts 1991). While in theory ecosystem functional and structural objectives could be set, estimating the appropriate values to maintain, and determining our progress in meeting objectives, would be difficult.

While the context perspective appeals to many ecosystem ecologists, it is in many ways too abstract and intangible to appeal to a broader public. Managing to maintain a minimal decomposition rate, a specific nitrogen mineralization rate, or even a minimum net primary productivity does not have the same appeal as maintaining a specific timber productivity, deer-herd size, or water yield. Even among ecologists, maintaining ecosystem function does not have the same appeal as maintaining minimum viable populations or biodiversity. We may recognize that objectives of biodiversity cannot be met without maintaining the ecosystem processes which sustain that biodiversity, but this is a rather indirect level of support that will likely prove insufficient.

THE ROLE OF ECOLOGISTS

Given the above dichotomy of viewpoints among ecologists (or more properly perhaps, range of viewpoints), what is the appropriate role for ecologists in implementing ecosystem management? There is again a wide range of views, and the following is a personal perspective:

- Ecologists must take responsibility for designing management systems that tell us not WHAT to manage for, but rather what CAN BE managed for, and what the ecological behavior of such systems would be.
- We have to achieve a synthesis of the object and context perspectives, and develop management systems that incorporate the essential elements of each.
- We have to clearly distinguish when we are operating in the object and context modes.

The first point concerns essentially philosophical issues. As ecologists, we obviously have strongly held views on the desirability of complex, intact ecosystems with well-developed ecosystem structure and function. However, I believe that ecological science is neutral on the appropriateness of different possible states for these ecosystems, and we should recognize that our preference for specific states or conditions is a value judgement. It is a value judgement based on ecological knowledge and insight, perhaps, but a value judgement nonetheless, and we should guard against portraying our value judgements as ecological science. The issue for ecologists is not to determine what is the "best" or "most natural" state for these ecosystems to be in, but rather to determine the set of possible states and the characteristics and behavior of each of these possible states. Specifically, what are the inherent dynamics from each state, are they sustainable, and to what extent do they achieve the specific objectives for each entity or process?

The second and third points are more technical in nature, and relate to our responsibility to develop management systems that reflect our ecological understanding, rather than the production-efficiency bias employed in previous resource-management systems. These two points emphasize what I feel is the critical challenge of developing ecosystem management. While I portrayed the object and context perspectives as a dichotomy, we must come to an understanding of the duality of ecosystem management, and we cannot afford to allow either perspective to become lost in the design of ecosystem-management systems.

RECOMMENDATIONS FOR IMPLEMENTATION OF ECOSYSTEM MANAGEMENT

ATOMS, ELEMENTS, AND MOLECULES

Given the above discussion and the desire to incorporate both the context and object perspectives of ecosystem management, I offer the following recommendations. The ideas presented here are the outgrowth of analysis of the above issues, and represent a starting point for discussion on ecosystem management. The nomenclature employed below is strictly for the sake of communication of ideas, and I do not propose it as a new standard.

First, let us recognize that we have to delimit ecosystems, and design systems that capture the best elements of both perspectives. Of the various proposals for recognizing ecosystem boundaries, I recommend the homogeneous-land-unit approach. I will call each unique combination of geology, geomorphology, potential natural vegetation, and soils an "element," and each actual example of an element on the landscape an "atom." Mobile organisms that occupy the landscape at a larger scale (e.g., wildlife and recreationists) I will call "diffuse entities." Atoms and diffuse entities interact through ecological processes, e.g., herbivory, dispersal, and provision of habitat.

For each element we need to develop a model (conceptual at first and then quantitative) that specifies the set of possible states for that element, and the set of possible processes associated with each state of that element. These models must include the inherent dynamics, disturbance response, and management response of each element. We need to know the effects of change in the atom on the diffuse entities, as propagated through ecological processes, as well as the effects of diffuse entities on the state of the atoms.

Finally, we need to develop a method of aggregation which reflects our understanding of ecological principles. I believe that this aggregation must not be hierarchical, but rather reticulate and anastomosing, reflecting the particular ecological processes which are most important. Individual atoms on the landscape are aggregated in higher-order structures which I will call "molecules." As examples, consider the aggregation of a specific atom, called the focal atom, into the following molecules. The hydrological molecule includes all those atoms in the same watershed, as well as the atoms in the nested higher-order watersheds downstream. The vegetation molecule containing the focal atom contains all those atoms within pollination or seed-dispersal range, regardless of the watershed in which they occur, and regardless of differences in geology, vegetation, or soil among the atoms.

The animal-habitat molecule containing the focal atom depends on the role of that particular atom to individual species or guilds, and the home ranges or migration paths of the animals, emphasizing the role of the focal atom not just as habitat but in maintaining landscape connectedness. The recreation molecule includes all atoms linked to the focal atom by trails, roads, or streams, with some consideration for viewsheds.

The critical point is that each atom is simultaneously in multiple-overlapping, but not nested, molecules, each defined by a specific ecological process or resource use. The molecules are highly variable in size and shape, with their distribution and boundaries again determined by ecological processes or resource uses. Whether or not two particular atoms in a landscape are part of the same atom depends on the process under consideration, not on proximity or adjacency. This suggestion is completely at odds with the current preference for nested hierarchical units, designed to mimic traditional taxonomic classifications (Avers et al. 1993, Bailey 1980, McNab and Avers 1994). For the reasons outlined above, I believe that nested hierarchical units will not work, and I realize that this is likely to be the most controversial element of my recommendations.

DIFFUSE ENTITIES

The effect of a change in an atom on the diffuse entities is determined by their response to the change in all associated molecules. For example, change in the vegetation of one atom will affect animal species by:

- direct effect of change on animal habitat
- indirect effects of change on habitat for potential predators or prey
- change in landscape connectedness as it affects corridors and barriers to movement.

Managing diffuse entities directly will affect the range of molecules with which they interact. For example, when changing the population size of a specific herbivore:

- The vegetation molecule includes all atoms likely to experience significant changes in vegetation structure or composition resulting from change in the herbivore.
- The biodiversity implications include the direct effects of the population change as well as the indirect effects from the change in vegetation within the vegetation molecule.

INFORMATION NEEDS AND TECHNOLOGICAL REQUIREMENTS

To implement ecosystem management in the manner I am recommending, a number of specific information needs must be met, and a significant amount of work on information analysis will have to be performed.

All areas within the largest boundary must have sufficient information to determine their atom type. Thus, there can be no missing pieces within the landscape, where a critical component of the definition of atoms is lacking. It is better to have comprehensive, qualitative, extensive information than detailed isolated information. This element of the information need I refer to as the need for homogeneity of detail in information.

We have insufficient manpower and money to perform the field-based inventory required to obtain the homogeneous data bases we require. Consequently, we will have to rely on statistical predictive models of resource distribution linked to GIS systems to achieve the homogeneity of data required. Considerable research effort will have to be expended in the design and testing of suitable predictive modeling approaches, including intensive field validation of prediction accuracy. Roberts and Cooper (1989), Lees and Ritman (1991), and Moore et al. (1993) discuss a range of useful techniques for this effort.

I have indicated a preference for a land systems-based ecosystem classification as most appropriate for ecosystem management. Whatever system is selected, it must be completed as soon as possible as it represents the basic information layer from which all management information must be abstracted. Given the work to date, however, I believe that it should be relatively easy to achieve this goal. Barnes and colleagues have demonstrated an extremely useful approach, but it remains to generalize the approach to areas with less site-specific data, or more general data such as collected by remotely sensed imagery or generated by predictive models.

We need mechanistic models of succession, disturbance response, and management response for all elements. I emphasize mechanistic models, as opposed to empirical models, as we will be required to predict the response of systems that have never been observed before to stimuli that perhaps have never been considered before. These models must calculate structural, compositional, and functional responses of the ecosystems. While the models should be comprehensive, they need not be highly detailed. For succession, we are in relatively good shape, and have a number of candidate, prototype succession models to evaluate. Work by Steele (1984), based on previous work by Huschle and Hironaka (1980), provides a strong basis for development of such a system. Roberts and Morgan (1989) describe a range of development issues based on these and similar models, and Roberts (1995a, 1995b) demonstrates the use of these models in spatially-explicit landscape simulation incorporating variable disturbance regimes. For broad-scale disturbance and management response we are in less good shape. Models which predict ecosystem response to fire, insect infestation, and pathogen outbreak are only in the initial stages of development.

The ecosystem dynamics models must retrieve data and display results on a spatially-explicit basis, with direct links to the GIS. Whatever databases are developed must reside in the GIS, and the predictive models we develop must use these data as the basic inputs in calculation. This implies, of course, that any information required by the models must be universally available. With respect to this issue, we are in pretty good shape for the basic vegetation and ecosystem dynamics models, but in very poor shape for the diffuse entities. How a herd of herbivores affects ecosystems in a spatially explicit manner, for example, requires the integration of animal behavior and foraging models with the vegetation and topo-

graphic elements of the GIS. We need to develop the conceptual models of how processes link specific locations across the landscape. I have previously given a few examples in outline, but the specifics of spatial integration of ecological processes are still largely unknown. Given these conceptual models, we need to develop computer algorithms which mimic the conceptual models, and implement the mechanisms of the conceptual models on data contained in the GIS. While we are struggling with the first objective, we are in our infancy with regard to the second. Significant amounts of research are required before we can tackle these problems for real ecosystems and landscapes of the size required to implement ecosystem management.

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Searching for Effective Natural-Resources Policy:

The Special Challenges of Ecosystem Management

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Abstract

No matter how elegant ecosystem management is scientifically, it will not reach its potential in western U.S., with its abundant public lands, unless it is effective public policy. Such policy is (1) an adaptive process, (2) utilizes the most appropriate science and technology, (3) is implementable, and (4) has low transaction cost. This paper focuses on the latter two characteristics which are shaped by social legitimacy, and proposes a procedure termed Collaborative Learning as a promising decision-making process for ecosystem management.

Two defining criteria of social legitimacy in contemporary American public policy are (1) policy solutions must be recognized as technically sound; and (2) if people's lives are affected, they must have a voice in policy process. The increasing sophistication of science and technology makes them less understood by the general public, and creates a dilemma between the narrow politics of expertise and a broad politics of public inclusion.

Land management of any form in western U.S., with its mixed land ownership, is complicated and constrained by deeply held public values; multiple world views, parties and issues; legal constraints; and an entrenched conflict industry. Ecosystem management compounds these difficulties by adding more technical complexity and uncertainty, a systems view, increased focus on mixed-ownership solutions, and the importance of institutional continuity.

Collaborative Learning (CL) is a framework for natural-resources policy making with public involvement. It is a hybrid between soft-systems methodology, which promotes learning and systems thinking, and alternative dispute resolution, which deals with value differences and strategic behaviors. CL stresses improvement rather than solution, situation over problem or conflict, concerns and interests rather than positions, progress over success, desirable and feasible change rather than desired future condition. Evaluations of CL conclude that the process broadens participants' understanding, improves communication between diverse communities, and implements improvements. And while strategic behaviors persist, there is increased rapport, respect, and trust among participants. It is well-suited to ecosystem management.

INTRODUCTION

Ecosystem-based management has an obvious foundation in the natural sciences. It incorporates ideas from a number of fields or theories in physical and biological science: geomorphology, disturbance ecology, conservation biology, etc. No matter how elegant the scientific theories, however, ecosystem-based management will not reach its potential on public lands until it is also effective public policy. That observation in no way denigrates the importance of the natural sciences, nor is it an argument that social or political sciences are more important than natural sciences. Particularly on public lands, or where there is a significant mixed public/private ownership (conditions that characterize most of the western third of the United States, and which will be collectively referred to throughout this paper as "mixed public lands"), ecosystem-based management will require our best efforts in both the natural and social/political sciences.

This paper provides a social science/public-policy perspective on the challenges created by the current focus on ecosystem-based management. It presents a simple frame-

work of policy effectiveness, and then examines the extent to which effective public involvement will be part of effective policy formation and implementation regarding ecosystem-based management.

The paper subsequently introduces a particular method for conducting public participation, Collaborative Learning, while emphasizing its applicability to ecosystem-based management on mixed public lands. Both the basic philosophy and intellectual heritage of Collaborative Learning are provided, in order to explain the essence of the technique, while not dwelling on details that are beyond the scope of this paper. The results of some Collaborative Learning facilitations of mixed public lands decision-making processes are presented.

POLICY EFFECTIVENESS

Sorting through the volumes that have been written about policy effectiveness, we perceive four basic concepts that capture the nexus of policy effectiveness and ecosystem-based management. They are:

- Adaptive process
- Utilizes the most appropriate science and technology
- Implementable
- Low transaction costs

Adaptive processes recognize that management is inevitably field experimentation of the current stock of knowledge and assumptions. With this as a guiding precept, adaptive processes strive to learn from those field experiments as quickly and reliably as possible, in order to test those fundamental assumptions and knowledge levels. Much of the focus of adaptive management is on natural systems; Lee (1993) provides an important recent attempt to integrate adaptive management into the policy arena.

Utilizing the most appropriate science and technology seems like an obvious criterion for policy formation, particularly when complex situations are involved. One must recognize, however, that "most appropriate" is a value statement, and for many technically trained specialists, it is synonymous with "most advanced," or "state-of-the-art." There are cases where advanced technical solutions to policy problems are in fact not the most appropriate, particularly when the costs of such solutions are too high or they result in policy recommendations that are not culturally or politically viable. The international development literature is replete with examples of highly technology-oriented proposals for development projects that illustrate that most-advanced technology and most-appropriate technology are not synonymous.

Implementability is another core concept of policy effectiveness. It is difficult to see how a policy can be defined as effective, if in fact it never produces results on the ground. Elegant models, intricate flowcharts, and bureaucratic plans may have their place in policy formation, but the benefits of policy are derived from what they accomplish. (While much of recent political science and public-choice theory argues that policies are primarily crafted to perpetuate bureaucracies, we are going to set that more cynical perspective aside for this paper.) Certainly the forest-planning process that has been conducted pursuant to the National Forest Management Act of 1976 exemplifies elegant policy that has had limited implementation. The linear-programming models that supported each forest's plan were immense, with thousands of rows and columns of data. Even so, the land allocations that many of the plans generated were subsequently appealed, and some have never been fully implemented. In regions such as the Pacific Northwest, the plans bear little resemblance to the ecosystem-based management efforts currently underway.

Finally, low transaction cost is a facet of policy effectiveness in many ways tied to implementability. Transaction costs are those expenses that society incurs to implement a policy, and all other things being equal, lower transaction costs imply more effective policy. If one policy creates a given set of benefits while avoiding expensive administrative appeals or litigation, it is arguably more effective than one that cannot. The ratio between the benefits of implementation and transaction costs is a standard benefit-cost analysis of policy effectiveness, and shows that a policy that never can be implemented is equivalent to having infinite transaction costs. In either case the benefit-cost ratio is driven toward zero.

Much of the discussion of ecosystem-based management focuses on either the criteria of adaptability or most appropriate technology. This paper focuses on the others: implementability and transaction costs. Without much loss of generality, we can focus on both of these by recognizing that they are shaped to a large extent by social legitimacy. If segments of society do not view a policy outcome as legitimate, and the stakes are high enough, they may coalesce into interest groups intent on impeding or preventing its implementation.

SOCIAL LEGITIMACY

Recognizing that social legitimacy is culturally located, i.e., its definition differs across societies and eras—we should focus on two criteria that define social legitimacy in contemporary American public policy:

1. Decisions should be made in a rational manner; policy solutions must be recognized as technically sound.
2. If people's lives may be affected by policy processes, then they should have a voice in those processes.

It is no coincidence that the first criterion broadly captures the more technical "adaptive" and "most appropriate science" criteria listed above, and that the second corresponds to the more process-oriented "implementable" and "low transaction costs" criteria.

This juxtaposition between technical competence and open process is a defining characteristic of American policy formation. Citizens demand technically sound decisions, but as situations become more complex fewer people have the technical background needed to either contribute or critique. On the other hand, these complex situations often touch people's lives in very fundamental ways. Our traditions of participatory democracy imply that those people should be at least consulted, if not directly involved. This creates a compelling dynamic between a narrow politics of expertise and a broad politics of inclusion, a dynamic that cuts across public-

policy disputes such as nuclear-waste disposal, health care, and land management. Finding ways to increase the quality of technical expertise, while simultaneously increasing the inclusivity of decision processes, is perhaps the fundamental paradox of effective policy formation.

Several laws illustrate this paradox between expertise and inclusion. The Administrative Procedures Act of 1946, the National Environmental Policy Act of 1969, the Federal Land Policy and Management Act, and the National Forest Management Act of 1976 all require high quality decision or planning processes, while simultaneously requiring either administrative appeals, public-disclosure documents, or public-involvement activities.

This dilemma has also captured the attention of scholars from several disciplines. Reich (1985), a political economist, argues that the limited success of post-World War II public administration stems from competing paradigms. Neither the paradigm of administration as technocratic analysis, nor the paradigm of administration as interest intermediation, pay sufficient attention to social learning activities that might benefit both. Yankelovich (1990), a pollster, sees improved political process coming from a citizenry working through complexity of modern policy situations. Lee (1993), an environmental scientist, contends that sustainable development will come from the integration of adaptive management—to deal with the scientific uncertainty and complexity—and political negotiation, which meets the need for an involved citizenry. Pierce et al. (1992), political scientists, refer to this paradox as the "post-industrial quandary," and see interest groups as playing important roles as information brokers and political actors.

Perhaps it is more important to focus on these authors' diverse academic traditions than on the specific ways that they address the paradox of technical competence and inclusive process. Finding an aspect of policy formation that has attracted attention from so many different fields implies that it is probably not a figment of one's idle musings, but neither is it likely to be easily resolved. Progress in ecosystem-based management on mixed public lands, and indeed progress on many wide-ranging and complex policy questions will depend on our progress on this paradox. We cannot view wild swings from purely technocratic to purely inclusive processes as progress. Our ability to develop processes that can truly identify and further the public interest hinges on our ability to enhance both.

THE CHALLENGES OF MIXED-PUBLIC-LAND MANAGEMENT

With this brief background on the fundamental paradox of policy formation as a foundation, what are the defining characteristics of mixed-public-land management? What is there about mixed-land management that seems to create the challenges that confound successful policy formation and implementation?

Several sources of complexity come to mind:

- Deeply held values
- Markedly different worldviews
- Multiple parties
- Multiple issues
- Legal constraints
- Entrenched conflict industry

Taken together, these attributes make public-land ownership as vexing a situation as a prudent person would undertake.

The deeply held values and markedly different worldviews mean that public-lands disputes are little less than cultural conflicts. For many people in the mixed-land states, the activities that define their core identities may involve the public lands. As one travels throughout the western states, one hears phrases like "I am a rancher," or "I am an elk hunter," not "I am in the beef industry," or "I like hunting elk." When public lands are at stake, the very places and activities around which people build their self-identities are on the table (Kemmis 1990). When one combines this intense link to the public lands with the range of views about how those lands should be managed, it is easy to see why disputes over them can move quickly through merely heated into white-hot.

The multiple parties and multiple issues mean that public-lands disputes are often structurally difficult to address. A rule of thumb in dispute resolution is that a large dispute has 12 or more participants; it is common to find several times that number in a public-lands situation. Moreover, some may live a considerable distance away from the specific land in question if federal lands are involved. How to involve these distant stakeholders, and what weight to give their views, are confounding questions. It is similarly common to have participants come and go throughout the process, and to have significant differences between the views of organizations apparently share similar ideological positions. There are moderate environmental groups, and more extreme ones, just as there are moderate and extreme commodity interests. It is not possible to invite one environmentalist and one commodity representative and have the range of interests adequately represented.

The legal constraints and entrenched conflict industry mean that any public-land decision process has precise procedural requirements that must be met, and that there are well-organized groups of advocates who will pounce on procedural errors to overturn any decision that they feel does not meet their needs. As such, decisionmakers' range of process opportunities is substantially limited; they do not have *carte blanche* to assess a situation and craft a unique process that meets the special issues at hand. They must comply with a daunting array of judicial mandates, policy directives, and legal precedents. In addition, the policy gladiators employed by the various interest groups are rewarded for the quality of their battles, not their compromises; they are only too willing to exploit procedural errors and adopt extreme rhetorical positions.

THE SPECIAL CHALLENGES OF ECOSYSTEM-BASED MANAGEMENT

As if the demands of public-land management are not enough, adding ecosystem-based management contributes even more. Notable among these are:

- Complexity and uncertainty increases
- Systems view is more important
- Mixed-ownership solutions are more important
- Institutional continuity is more important

One of the goals of ecosystem-based management is to consider more issues, acres, and years in one's decisions. This certainly raises the technical complexity, but it creates an additional policy challenge as well. Since ecosystem-based management is based on emerging disciplines such as conservation biology, there are few guarantees that management will create the precise objectives that models might predict. Probabilistic assessments are perhaps the best one can reasonably produce.

This fundamental uncertainty allows interest groups to establish unrealistically stringent burdens of proof as preconditions before any management activities are begun, thus effectively preventing implementation. In the spotted owl conflict, both of the major combatants have used this tactic. Environmentalists have argued for no more harvesting on the federal lands because there are no guarantees that the owl will survive if harvesting persists. Industry proponents have likewise argued that there is no proof that protecting critical owl habitat will guarantee species survival, nor is there any proof that the owl will not adapt and survive if harvesting continues. Both sides are right—there are no guarantees with ecosystem-based management.

A systems view is essential under ecosystem-based management. The ability to understand the linkages between the various physical and biological components of an ecosystem are obviously central to success of this emerging management philosophy. It is equally important, however, to understand the links between social structure, land ownership patterns, existing technology, and policy processes.

Mixed ownership of public and private land is common throughout the western public-lands states, and our ability to deal with this historical artifact will determine the future of ecosystem-based management to a considerable extent. The nineteenth century land-grant policy to railroads and homesteaders has created a pattern of "checkerboard" lands (alternating one-mile squares) in the former case, and a pattern of private lands in the low elevations and public land above them in the latter case. In both situations, no single owner controls a block of land that mirrors any significant ecosystem-based processes, and any policy that intends to reflect ecosystem function must cross ownership boundaries. In addition, there is considerable legal ambiguity in the authority that any federal land-management agency has to either consider the activity of other land owners in its' own planning, or to regulate the behavior of nearby landowners.

Finally, ecosystem-based management attempts to manage lands over biologically significant periods of time. When dealing with natural processes where the effects of management activities may not be fully realized for decades, as is often true of forests, institutional continuity is crucial. The frequently changing political philosophies of the executive branch makes such continuity difficult on federal lands, as do fluctuating budgets and the agencies' tradition of frequent personnel transfers. Such continuity is equally important on private lands, where uncertainty over endangered-species management in the Pacific Northwest is reportedly compelling small landowners to harvest timber earlier than they had planned, and where estate laws may force family ranches, farms, or forests to be somehow "cashed out" to pay estate taxes.

Given this inventory of challenges facing ecosystem-based management on mixed lands, the line between realism and pessimism becomes blurred. It may be that only the politically naive would believe that ecosystem-based policies will be easily crafted and implemented. That is not to say that the transition to ecosystem-based management is folly; indeed the mixed lands of the western states deserve nothing less. It merely assures that ecosystem-based management will require our best natural and social science, as well as our best policy processes. The remainder of this paper presents a brief overview of Collaborative Learning, a recent innovation that has been designed to accommodate the complexity of ecosystem-based management on mixed lands.

COLLABORATIVE LEARNING

Collaborative Learning (CL) is a framework designed for natural-resource-policy decision making and public involvement in policy discussions. It emphasizes activities that encourage systems thinking, joint learning, open communication, and a focus on appropriate change (Daniels and Walker 1993). Collaborative Learning is a hybrid of work in two areas:

- Soft systems methodology (SSM)
- The alternative dispute resolution (ADR) fields of mediation and negotiation

By incorporating features of SSM and ADR, Collaborative Learning promotes *working through* the issues and perspectives of a situation.

FROM SSM: LEARNING AND SYSTEMS THINKING

The origins of Collaborative Learning are in "soft systems methodology" (SSM). Soft systems is an application of theoretical work in systems and experiential learning (Wilson and Morren 1990). SSM stresses that learning and thinking systemically are critical to planning, making decisions about, and managing complex situations like natural-resource controversies. Thesesystems thinking and learningare areas that alternative dispute resolution methods, including mediation, typically disregard or consider peripheral to the settlement task (Figure 1). As Flood and Jackson (1991) observe, SSM "is doubly systemic since it promotes a systemic learning process, orchestrating different appreciations of the situation, which is never-ending, and it also introduces systems models as part of that learning process. The systemic

learning process aims to create a temporarily shared culture in which conflicts can be accommodated so that action can be taken" (pp. 177-178).

Figure 1. Collaborative learning as a hybrid.

ELEMENTS	SSM	ADR
Promotes Learning	High	Low
Emphasizes Systems Thinking	High	Low
Deals with Value Differences	Low	High
Handles Strategic Behaviors	Low	High

FROM ADR: VALUES AND STRATEGIC BEHAVIORS

While CL's emphasis on learning and systems thinking come from SSM, SSM does not deal well with value differences and strategic behaviors such as negotiation. The alternative dispute resolution (ADR) areas of mediation and negotiation do, and serve as a second foundation for Collaborative Learning. Mediation, the intervention of an impartial third party into a dispute, deals well with significant value differences. "Value disputes," Moore (1988, p. 256) observes, "are extremely difficult to resolve where there is no consensus on appropriate behavior or ultimate goals." Yet mediators, via identification and reframing methods, can address value conflict. Specific techniques include (1) transforming value disputes into interest disputes, (2) identifying superordinate goals (both short and long term), and (3) avoidance (Moore 1986, p.178; Gray 1989).

Collaborative Learning deals with parties' strategic behaviors by incorporating methods designed to promote collaborative, integrative negotiation. CL encourages parties to identify and assess innovative approaches for settling their differences, including logrolling, bridging, non-specific compensation, etc. (Lewicki and Litterer 1985). CL facilitators, like mediators, often use transformative strategies that encourage parties to engage in role reversal, mirroring, and future orientation.

COLLABORATIVE LEARNING AND COMMUNICATION

Successful Collaborative Learning processes sustain quality discourse: constructive discussion of ideas, collaborative argument, and interaction. Communication competence encompasses these elements, providing a dimension of Collaborative Learning that goes beyond SSM and ADR. CL promotes productive dialogue that ideally permeates the entire CL experience. CL communication competence is fostered through the development and implementation of discourse and interaction guidelines (e.g., "ground rules" that value diversity), facilitation, and taking stock.

Collaborative Learning encourages competent communication and quality discourse by emphasizing conflict and negotiation competence (Walker 1992), and a variety of interrelated communication "skill" areas; elements of a collaborative communication competence "system." These include: (1) listening skills, (2) questioning and clarification skills, (3) feedback skills, (4) modeling skills, (5) social cognition skills, (6) dialogue skills, and (7) collaborative argument skills (Daniels and Walker 1993).

COLLABORATIVE LEARNING: FROM PROBLEM-SOLUTION TO SITUATION IMPROVEMENT

Collaborative Learning encourages thinking "differently" about controversies and policy-decision situations. Thinking differently involves reframing; literally changing the language and perceptions of natural-resource conflicts. Collaborative Learning:

- Stresses *improvement* rather than solution
- Emphasizes *situation* rather than problem or conflict
- Focuses on *concerns and interests* rather than positions
- Targets progress rather than success
- Seeks desirable and feasible change rather than desired future condition
- Encourages systems thinking rather than linear thinking
- Recognizes that considerable learning—about science, issues, and value differences—will have to occur before implementable improvements are possible.

Drawn from SSM, "situation improvement" is a critical component of Collaborative Learning (Checkland and Scholes 1990, Wilson and Morren 1990). Natural-resource controversies are often discussed in terms of "conflict-resolution" or "problem-solution" (e.g., Crowfoot and Wondolleck 1990). Doing so imposes a burden on parties in conflict. They may be immersed in a complex, intractable, and seemingly irresolveable conflict. A "conflict resolution" frame implies a "total solution" standard for success. Collaborative Learning redefines the conflict or problem as a "situation." Rather than trying to find "the solution," parties develop improvements over the status quo situation. Results are measured as "progress" rather than by some absolute standard of "success."

Constructing improvements is a learning process. Parties are encouraged to understand situations in terms of their complexity. This is fostered by CL activities that require systems thinking rather than linear, single-issue perspectives. Based on their systemic learning, CL participants focus on concerns and interests related to the situation instead of taking positions or making demands. Improvements are based on these concerns, and are ultimately debated to determine if they are both technically desirable and culturally feasible.

COLLABORATIVE LEARNING IN PRACTICE

Collaborative Learning encourages people to learn actively, to think systemically, and to learn from one another about a particular problem situation. The first stages of CL emphasize common understanding. Activities might include information exchange, imagining best and worst possible futures, and visual representations of the situation, perhaps through the use of "situation/systems" maps. In middle

stages, CL participants focus on concerns and interests regarding the specific situation, and how those concerns relate to other concerns. Out of these concerns, CL parties identify possible changes that could be made: "situation improvements." In latter stages, the participants debate these improvements, addressing whether or not they represent desirable and feasible changes in the present situation.

Throughout the CL process, participants talk with and learn from one another in groups of various sizes. For example, a CL process may use a "2-4-8" approach to discussing situation improvements. After the CL participants develop improvements, they discuss that improvement with one other person. Those two join two others and talk about each person's improvements. Those four join four others and the process continues. Within these discussions, active listening, questioning, and argument are respected. People clarify and refine their improvements through dialogue. Consistent with the theme of "working through," Collaborative Learning emphasizes "talking with" rather than "talking at."

RESULTS FROM COLLABORATIVE LEARNING APPLICATIONS

We have used Collaborative Learning in various settings, including public involvement situations involving as many as 90 people. Collaborative Learning has been applied in partial-day, full-day, and multi-day meeting formats.

The results of these applications indicate that a Collaborative Learning framework can help parties make progress on a problem situation (e.g., Walker and Daniels 1993). CL process evaluations indicate that:

- Participants' understanding of the situation is broadened
- Concerns are expressed and discussed
- Improvements have been developed and implemented
- Strategic behaviors persist
- Relationships improve

Through CL activities such as mapping, parties see the situation as a complex system of issues. Doing so broadens their understanding of the situation. CL promotes discussion of stakeholders' concerns. From these concerns, parties develop tangible improvements that reflect their understanding of the particular situation as a system.

CL provides a structured approach to discussing and improving a problematic situation, such as those inherent in ecosystem management. CL does not require any reallocation of decision authority, nor does it try to limit parties' strategic behaviors. Self-interest typically motivates people to participate in a CL process. Further, CL does not require consensus. Parties' agreement on an issue or broadening of self-interest to include the interests of others stem from parties' own choices, based on their understanding of the situation and willingness to work through issues with others.

OTHER COLLABORATIVE LEARNING BENEFITS

Collaborative Learning presumes that situations are dynamic, systemic, and changing. CL is a framework that can be adapted to a particular situation to generate:

- Dialogue among diverse communities: scientific, public, administrative
- Integration of scientific and public knowledge about the problem situation
- Increased rapport, respect, and trust among participants

COLLABORATIVE LEARNING AND ECOSYSTEM MANAGEMENT

Collaborative Learning is both philosophically and practically compatible with the basic tenets of ecosystem management. First, ecosystem management's commitment to ecological analysis and methods is consistent with CL's emphasis on a "human activity system" view of situations. Second, CL needs the best science and technologies that ecosystem management features to be a part of CL's learning activities. CL provides a venue for scientific and technical knowledge to be part of the civic discourse. Third, the CL framework adapts well to public participation. CL accommodates open participation, values local knowledge, and respects citizen interest and commitment. Fourth, CL provides the opportunity for the development of shared visions and goals upon which partnerships may be based. Collaborative Learning encourages a holistic, systemic view of a situation. It respects the complexity of a situation in a manner similar to ecosystem management.

WHAT COLLABORATIVE LEARNING IS NOT

Collaborative Learning, while beneficial within an ecosystem-management approach, is no panacea or "silver bullet." It is one of possibly many frameworks that can involve people in meaningful learning and discussion about ecosystem-management situations. It does not stress or demand consensus. It does stress learning, understanding, and the development of improvements in the situation. CL does not foster the development of a group "mentality" or "recommendations." Rather, CL encourages parties to make progress on improving the situation as they work through issues, values, and concerns.

CONCLUSION

In terms of understanding the policy challenges posed by ecosystem-based management, this paper's discussion of Collaborative Learning should be viewed as illustrating the kinds of policy processes that ecosystem-based management is likely to require. Various forms of public-policy formation that have a rich agency/citizenry dialogue at their core have been developed in recent years, dating back to at least Friedmann's transactive planning (1973). The social and political forces that spawn these efforts are at least as likely to increase as abate. Certainly the current trend to "reinvent

government" illustrates this trend (Osborne and Gaebler 1992).

The task of designing policy processes that can accommodate ecosystem-based management essentially requires matching the tool to the task. We must think very carefully about the fundamental characteristics and challenges of ecosystem-based management, and then design systems that are compatible with those characteristics, and robust in the face of the challenges. Doing less is analogous to trying to screw in a lightbulb with a hammer, or paint a room with a screwdriver.

Collaborative Learning is particularly applicable for ecosystem-based management because it has been designed specifically to address the policy challenges of mixed public lands. As a result, it has three features that make it well suited to ecosystem-based management: (1) it explicitly adopts a systems approach to the situation and works to improve the participants' systems understanding; (2) it is more modest in its expectations for progress than the more frequently used rational-comprehensive models which seek solutions; and (3) it expects and attempts to accommodate a wide range of worldviews about land management and the strategic behaviors that those worldviews are likely to generate in controversial situations.

It is our prediction that any situation in which ecosystem-based management makes progress will feature at least these three characteristics: a systems approach, realistic goals, and high political acumen. Whether these attributes arise spontaneously or result from carefully thought-out method is immaterial. If a structured method is used, it is similarly irrelevant if it goes by Collaborative Learning or any other name. Perhaps the only thing that matters, at the core, is that it make progress on the paradox of public deliberation: it must be able to generate technically sound decisions, while simultaneously allowing stakeholders rich and meaningful voice in the process. The scientific burdens of ecosystem-based land management, combined with the range of interests in the mixed public/private lands, appear to require nothing less.

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Legal Problems and Powers Inherent in Ecosystem Management

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Abstract

The idea of ecosystem management is elusive, but it is not nearly as novel as many have assumed. There are difficulties inherent both in the lack of semantic precision and the multiple ownerships faced by ecosystem management. There are precedents for regulatory systems that transcend sovereign and ownership boundaries. At the federal level, Congress has adequate constitutional power to ordain ecosystem management. Exercise of that power will rarely if ever constitute a taking. Congress implicitly has authorized the federal land-management agencies to manage for ecosystem sustainability within reservation borders, but federal agencies lack power to force ecosystem restraints on adjoining landowners.

INTRODUCTION: SPECULATIONS ON HYPOTHETICAL QUESTIONS

Discussing "Legal Problems in Transboundary Ecosystem Management" necessarily is an exercise in speculation. Forecasting legal consequences is a hazardous business in any context, but it is more difficult when contemplating such an amorphous concept as "ecosystem management" than in most instances. The difficulties spring from various sources:

1. The common phraseology is rife with words that lack precise definition.
2. The subject apparently is as much political as scientific or legal, and perhaps more so.
3. Legislative guidance is lacking.
4. Human conceptual abilities are limited.
5. American legal, managerial, and scientific histories militate against wider or deeper regulatory constructs.
6. Fragmentation of law, ownerships, sovereignties, and systems complicate the picture enormously.
7. Anti-federal attitudes in the West, coupled with fears of regulation and of higher costs, are bound to inspire emotional opposition.

On the other hand, the current movements toward and sentiment for ecosystem management carry with them many hopeful portents and possibilities. Even such an ambiguous notion is capable of being translated into far more balanced and effective land-management strategies. More fundamentally, ecosystem management if generally accepted offers the promise of breaking out of the ruts of legal, economic, and scientific history in the Western United States (and elsewhere, of course). The peculiar history of the West has long mired progress concerning rational natural resources allocation there (Coggins 1994).

Change is long overdue. The West is a far different place than it was just a few decades ago. Consider this one fact: more people are employed by the Mirage Hotel in Las Vegas than are employed in all areas of agriculture in all of Nevada. And in spite of the relatively depressed state of all natural-resources industries in the Intermountain West over the past decade, that area is the fastest growing, economically, in the nation (Rasker 1994).

The major legal questions necessarily arising from ecosystem management, as generally visualized, are these:

1. Does any government, and especially the federal government, have power to require nongovernmental owners to refrain from doing things that are inconsistent with ecosystem management?
2. Assuming such a power, are the regulated landowners entitled to compensation for a "taking" of their property rights or interests?
3. Assuming such a power, has the Congress authorized any federal agency to exercise it, and if so, to what extent?

After laying out some semantic and precedential background, this paper will address those questions in that order.

THE PROBLEMS OF SEMANTIC IMPRECISION

No amount of semantic refining can change the fact that "ecosystem management" will always be an arbitrary, artificial, and amorphous concept. Neither "ecosystem" nor "management" is susceptible to an agreed, definitive meaning. Nor are many of the allied terms in common usage.

First, it is impossible to define or delineate a self-contained ecosystem. No matter how large an area is designated, or by what criteria, the area is always connected to or dependent upon other stuff, other areas, or other people. One can, for example, draw lines around what you decide is the "Greater Yellowstone Ecosystem," but the transient or alien components of that ecosystem will be unimpressed by your remapping efforts. The air, the water, the birds, and so forth are there only temporarily, on their way to somewhere else. Similarly, any area chosen is subject to activities thousands of miles away, such as manufacturing plants that originate acid rain. Ultimately, the whole business is powered by an engine 93 million miles away which is impervious to human management. And, of course, the system is dynamic; change is the only constant.

The inability to define or designate with any real scientific precision does not of course render the ecosystem-management concept futile or irrelevant. In fact, this symposium, in which speakers universally recognized the lack of precise meaning, demonstrates that imprecision may be a positive strength, at least initially. Natural- resources managers have long lived with terms that were never precisely defined, terms such as "conservation," "fair," "environmental," "efficient," "sustained yield," and so forth (e.g., Coggins 1981a). The necessity of mapping, of creating new boundaries, is not obviated by the understanding that such boundaries cannot ever be perfect. In spite of obvious semantic problems, there are, just as obviously, enough common strands in the commentaries to import some real degree of meaning into the notion.

The first idea inherent in ecosystem management has to do with scope: proponents argue persuasively that the management focus must be wider and deeper (e.g., Keiter 1994). The primary consequence of that focus is a relative disregard for established human boundaries in favor of new boundaries founded on different criteria (Keiter 1989, 1994). Within the relevant ecosystem area, as geographically delineated, managers contemplate land-use planning of greater or lesser formality resulting in land-use controls as the main mechanism to achieve the broader focus. In the end—and although proponents seldom put it so bluntly—they contemplate a system in which all landowners within a designated area will be forced into doing or refraining from doing certain things (e.g., Sax 1993). The private owners will not like it.

But ecosystem management also implies ends as well as means. A major objective of most proponents apparently is biodiversity preservation (Keiter 1990, 1994, USFS 1993). Also implicit in the ecosystem-management concept are such things as consideration of cumulative environmental effects from all causes acting on the chosen ecosystem (e.g., Keiter 1990). The new "balance" sought by ecosystem managers will emphasize continued future productivity of all resource values more than has typically been the case on public or private lands (Coggins 1981b, 1994). Subordination of commodity production, or at least marked deemphasis, is a common theme.

Finally, though not exclusively, ecosystem management premised on broader planning should be more proactive than reactive (e.g., Keiter 1994). If these changes are ever accomplished, it will indeed be a revolutionary development in public natural- resources law (Coggins 1994, Coggins and Glicksman 1990).

So far the discussion has concerned the first word in the phrase "ecosystem management," but the second word is just as problematic, if not more so. "Management" may be the commonest word in all of public-land and resources law, not to mention many other contexts. We speak of land management, multiple-use management, intensive management, wildlife management, demand-side management, wise management, and all kinds of management. And yet, what exactly does the word mean? One version is that it means "the organization or coordination of natural resource uses" (Loomis 1993). That is simply far too vague to be helpful. The only good definition of "management" yet located is: "that which managers do" (Coggins and Ward 1981). In the end, what managers do is to manipulate people and things, sometimes for predetermined ends (Trustees 1981).

Somewhat the same could be said about "science." The word has an almost metaphysical resonance of impartial rationality. Given that scientists are also human, that stern view bears little relationship to the realities of science in practice, where unscientific politics seem to be as rampant as elsewhere (e.g., Weinstein 1991). The natural-resource sciences long have operated with assumptions and techniques that have more to do with the uses of the supposedly scientific information than with the neutral, unvarnished truth (Coggins 1984).

THE PROBLEMS WITH SOVEREIGN AND OWNERSHIP BOUNDARIES

Human boundaries are one of the biggest obstacles that ecosystem management is likely to face, because natural systems and fauna seldom respect lines drawn on maps. The Anglo-American legal system (and most others) demands boundaries for reasons both of sovereignty and ownership, but the present boundaries for both purposes bear only incidental relationships to ecosystems.

In the East, most land is private. In the West, however, the federal government is the 800-pound, landowning gorilla, and the states retain significant ownership in the blue rash, state-section patterns (Bruce and Rice 1994). Further, the private owners homesteaded or outright stole the most productive lands and water rights (Coggins 1994). Every category of landowner will be resistant to common regulation for one reason or another.

The federal lands are not monolithic nor homogenous. They have been divided and zoned into almost innumerable categories, and are governed by four different agencies (Coggins and Glicksman 1990). The classification of a federal parcel, not its geology or biology, defines permissible, mandatory, or prohibited human activities on it, like a super zoning system. Zoning fragmentation is bound to complicate ecosystem management, especially since the federal agencies do not always cooperate fully with one another (Sax and Keiter 1987).

State land ownership is a problem for a different reason. States are not free to do with state-owned lands whatever they want to. They are instead required by law to obtain fair-market value for use of them and to devote the proceeds exclusively to public education (Fairfax et al. 1992, Bruce and Rice 1994). So, even in the rare case when state and federal managers are in full agreement over an ecosystem-management regime, state-trust law may prevent state managers from carrying out the agreement.

Private ownership of land in the West will be an even bigger obstacle to ecosystem management. Western private landowners have the best lands and the worst attitudes (Coggins 1994). Start with inholdings: some are in fee, and some—such as grazing permits or unpatented mining claims—are partial or temporary, but they are all private property of some sort (Laitos and Westfall 1987, Mansfield 1993). Add the transcontinental railroad checkerboard-ownership patterns (Leo Sheep 1979), the strip holdings along streams (Gates 1968), and the anti-federal hostilities in the rural West: the result is a mess.

Divisions in ownership and sovereignty are bound to complicate ecosystem management because different owners and different sovereigns have different objectives. Voluntary cooperation is unlikely if money or independence are at stake. Sweet reason and cooperation are not prominent western characteristics. These are not insuperable obstacles, however.

QUESTIONS OF PRECEDENTS, POWERS, AND PAYMENTS

The fact is that governments at all levels have long found it necessary or expedient to enter into binding transboundary agreements or to commence transboundary projects that incidentally governed and coerced private landowners and other governments. These precedents have resulted in judicial opinions demonstrating that at least certain forms of transboundary regulation are beyond reasonable constitutional challenge.

DEVELOPMENTAL PRECEDENTS

Consider for a moment the developmental history of this country. Canals, railroads, reclamation projects, flood-control projects, interstate river compacts, hydropower developments, and so forth—all of these were transboundary in nature (Gates 1968). And, in every such case, courts agreed that the federal and state governments were empowered to encourage or undertake such internal development projects (Leo Sheep 1979, Gerlach 1950, Oklahoma 1941, Texas 1983). On a lower level, it is now common and accepted to force unitization of oil and gas fields for the overall benefit of all owners and for public purposes (Kramer and Martin 1989).

INTERNATIONAL PRECEDENTS

Transboundary arrangements also are common at the international level. The United States is a party to treaties that allocate and protect natural resources and that even call for cooperative or joint management of certain land and water areas. Migratory birds (Coggins and Patti 1979) and the Great Lakes (Frances 1989) are examples. The Supreme Court held in 1920 that federal legislation implementing a treaty was valid even if Congress otherwise lacked power to legislate in the disputed area (Missouri 1920).

REGULATORY PRECEDENTS

In recent years, Congress has often used transboundary mechanisms for land and resource protection. In terms of transboundary or migratory resources, two wildlife examples stand out. First, migratory birds. Three or four generations ago, the federal legislature saw that a state-by-state approach could not rescue or preserve a national resource, so the federal government took the lead in establishing an international, national, regional, state, and local regulatory system (Migratory Bird Treaty Act of 1918, Coggins and Patti 1979). The key is comprehensiveness. No migratory bird can be killed or captured without either direct or indirect permission from the regulators (MBTA § 703, 704, 712). By and large, the Migratory Bird Treaty Act has worked well, especially in contrast to the ad hoc chaos it replaced.

Experience under the Endangered Species Act (ESA 1973) provides even more telling examples. Originally, the ESA was only invoked in crisis situations (TVA v. Hill 1978). Now, with its critical habitat provisions being implemented, the ESA has become a quasi-ecosystem management statute (Keiter 1994, Flournoy 1993, Seattle Audubon 1991, Trinity County 1993, Northern Spotted Owl 1991). The northern spotted owl has brought logging in the Pacific Northwest old-growth forests to a screeching halt (Jefferson 1993). That likely is but the tip of the future iceberg. When the salmon runs that should be listed are listed, every cause of endangerment, and they span a wide spectrum, will come under critical scrutiny (Wilkinson and Conner 1983). All this of course is totally or mostly independent of ownership or sovereign boundaries. In fact, a court in Hawaii ordered the state to remove herds of sheep and goats from a state-owned mountain because they were destroying the habitat of an endangered bird (Palila 1988, but cf. Sweet Home 1994).

JOINT LAND MANAGEMENT PRECEDENTS

Even more to the point is the recent trend of creating multiple-jurisdiction areas for joint management under federal leadership. The New River Gorge National River (NPRA § 460m-15, Moore 1986), the Pine Barrens in New Jersey (NPRA § 471, Collins and Russell 1988), the Tahoe Basin (Strong 1984, Fink 1991), and the Columbia River Gorge National Scenic Area (Blair 1987) all have in common diverse ownership and diverse sovereigns operating under jointly-agreed land-use controls (Coggins and Bergstrom 1994).

Courts have held for a century that the United States has power to regulate use of adjacent private or state lands if that land use threatened to interfere with the purposes for which the federal tract had been reserved (Camfield 1897). Thus, for example, the federal government can outlaw snowmobile use on private land within a federal canoe wilderness area (Minnesota 1981). Congress has taken that basic notion much further in creating special management areas in which

most of the land is privately owned, but all owners must jump to the federally orchestrated zoning tune.

The most elaborate and far-reaching mechanism of this kind is the Columbia River Gorge area. There, the states entered into a compact, approved by Congress, for creation of a joint zoning and management authority in cooperation with the federal land- management agencies (Blair 1987). Even though the new interstate authority can impose extremely restrictive land-use controls to protect the scenic and ecological integrity of the area without compensation, a half dozen court decisions have upheld the new system (CGU-PPP 1992, Broughton Lumber 1991, 1994, Klickitat County 1991, W. Birkenfield 1993).

PRECEDENT AND POWER SUMMARY

The basic point is that regulation or management extending over ownership or sovereign boundaries is hardly a novel idea. Boundaries are not forever and always immutable or impermeable. In the case of the federal lands only, Congress could, tomorrow, change the boundaries between management systems it had earlier established. It could, for instance, abolish the BLM as a land manager, put all of its lands under the Forest Service, and solve many jurisdictional problems instantly (Coggins 1994). State boundaries cannot so easily be changed, but interstate compacts can overcome such obstacles (Feldman 1992). Similarly, private-property rights have never been absolute: state and federal governments can define and regulate interests in real estate and uses made of it in innumerable ways (Laitos and Westfall 1987, Mansfield 1993) The wisdom of strict land-use controls for whatever purpose always is debatable, but the constitutionality of their imposition is seldom even debatable (Euclid 1926, Locke 1985, Midkiff 1984).

PAYMENT FOR TAKING?

Will the federal or state governments have to pay any landowner whose lands are economically affected by ecosystem management? Almost certainly not. In order to constitute a taking under the Fifth Amendment, the government must either take title and possession (which will occur only if there is a formal eminent-domain proceeding) or almost totally destroy all monetary value of the property for insufficient reason (Lucas 1992, Agins 1980). The latter test is very difficult for a landowner to meet. Since 1922 (Mahon 1922), the United States Supreme Court has only once decreed that a taking occurred, and that concerned the imposition of an easement across private beach property (Nollan 1987). Examples of actions that did not amount to takings include:

1. Protected wild horses eating private grass (MSLF 1986).
2. Grizzlies killing private sheep (Christy 1988).
3. Forfeiture of a mining claim for being one day late in filing (Locke 1985).
4. Air pollution regulations that force a factory to shut down (Union Electric 1976).
5. Denial of right to sell birds legally taken (Allard 1979).
6. All kinds of zoning (Euclid 1926).

QUESTIONS OF CONGRESSIONAL AUTHORIZATION

Whether the federal government has power to coerce landowners and whether it has to pay for their discomfiture are the easy questions. Whether Congress has authorized its agents, the land-management agencies, to manage on a transboundary ecosystem basis is more difficult. Agencies have only those powers that Congress has delegated to them (Stein 1977). Congress has never specifically said to any agency, go and manage ecosystematically. Still, however, this paper concludes that each of the four federal agencies has adequate authority to practice ecosystem management, but only within the borders of the federal reservations.

INTERNAL ECOSYSTEM MANAGEMENT

Although each agency has somewhat different statutory mandates and missions (Coggins and Glicksman 1990), all are premised to a considerable degree on what can roughly be characterized as ecosystem health. The multiple-use, sustained-yield laws that supposedly govern the Forest Service and BLM specifically state that all surface resources are to receive equal consideration and use of them cannot impair the productivity of the land for any of the others (MUSY §§ 528-531, FLPMA §§ 1702, 1732). Further, both agencies are instructed to manage for watersheds, which is a shorthand way of saying ecological stability (Coggins 1991). The Park Service and the Fish and Wildlife Service have even broader mandates (NPSA § 1, NWRSAA § 668dd). All four agencies have the power, not always exercised, to tightly control human activities even if they cannot outright forbid them. Finally, in virtually every situation where ecosystem management will be seen as necessary, other federal and state laws, from the ESA to the Clean Water Act, and from FLPMA to the Wilderness Act, likely will have a pro-ecosystem bearing.

TRANSBOUNDARY ECOSYSTEM MANAGEMENT

This paper's final conclusion will be less popular with the environmental ideologues in the audience. That is: current law does not empower any of the four federal agencies to extend their regulatory reach across existing boundaries to state or private land use, even if the target is in the same ecosystem. All can enter into cooperative agreements with adjacent landowners, but the power to coerce them is lacking.

Thus, additional legislation will be required before ecosystem management will become a transboundary reality (Coggins 1994). Senators and representatives have proposed relatively small-scale versions, such as the park protection bills of the mid-1980s, but none has been enacted (Coggins 1987, Keiter 1985). In some cases, such as the Everglades, existing law provides limited means for abating activities harmful to the park ecosystem occurring on private property. But there simply is not any general statutory authority for the federal agencies to impose ecosystem-protection requirements on state and private landowners.

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SESSION 2. CASE STUDIES: WHO'S DOING IT?

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THE APPLEGATE PARTNERSHIP, OREGON

THE TROUT CREEK MOUNTAIN PROJECT, OREGON

THE FLATHEAD BASIN, MONTANA

THE GREATER YELLOWSTONE ECOSYSTEM

A Community-based Approach to Forest Management in the Pacific Northwest:

A Profile of the Applegate Partnership

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Abstract

Varied interest groups joined together as the Applegate Partnership to attempt a collaborative process of forming an ecologically-based forest management plan for the Applegate Watershed, an ecologically unique area. A history of this area shows how the land was used for mining, then subsistence ranching, federally-owned and managed areas, and most recently people settling in the area during the back-to-the-land movement of 20 to 30 years ago. Out of these constituencies has come the Partnership. The three major task areas for such a community-based plan to develop are ecosystem assessment; community assessment, inventory, involvement, and monitoring; and, locally-based implementation. Comprehensive ecosystem-management planning requires the consideration of both ecological and social/economic issues and consequently, assessments of both are essential.

Based on the Partnership experience, five elements emerge as important considerations: (1) mixed interests necessitate building partnerships among stakeholder groups; (2) there is a substantial commitment needed to build and maintain broad-based community support; (3) comprehensive ecological and community inventories, involving scientists and community-development practitioners, are essential to develop a full view of the dynamics of forests and communities under consideration; (4) mechanisms for implementation of activities need to direct work to local workers, to maintain quality and consistency of work, and to ensure that economic and social benefits are retained in the community; and, (5) long-term success depends on a broad base of support, otherwise political entropy will favor external, centralized control of local resources.

INTRODUCTION

Using standard measures of health specific to each, both forests and forest-based communities in the Pacific Northwest are suffering serious declines in their overall well-being. In forests, decades of industrially-oriented forest management and harvest have resulted in multiple impacts on forest vitality including reductions in species diversity, site productivity, water quality, increase in insect and disease mortality, threat of wildfire, loss of species, and a range of other destructive forest influences.

Correspondingly, economic vitality in many forest-dependent communities has declined dramatically over the past decade, despite record levels of production in the timber industry. As the multiple influences of automation, log-supply disruption, and global trade in forest products forced a restructuring of the timber industry, unemployment rates have climbed well into the two-digit range. Poverty rates have dramatically increased. Expressions of social deviance such as substance abuse, crime, and domestic violence have escalated, and many of the most educated or entrepreneurial individuals in these communities, especially youth, have left.

The increasing polarization and conflict in the Pacific Northwest over federal forest management, culminating in the present injunctions on timber harvests in the 2.2 million acres of BLM and Forest Service (USFS) lands in Oregon and California, have compelled the federal government to address both the issues of forests and communities as it reformulates its forest-management policies.

Perhaps more important, however, are the responses of the communities themselves. In many areas, community residents have become exasperated with the political deadlock of warring interest groups and have begun to formulate their own solutions to the problems. In some cases this has led to calls for local control or the ouster of federal land-management agencies. In others, like the Applegate Valley of southern Oregon, residents joined together across their various interest allegiances to attempt a bold collaborative pro-

cess of formulating an ecologically-based management plan for this 500,000 acre watershed. This paper profiles the efforts of these Applegate advocates and the strategy they have developed to balance both ecological and social/economic concerns.

THE APPLEGATE PARTNERSHIP

GEOGRAPHIC SETTING

The Applegate River watershed encompasses approximately 496,500 acres in southern Oregon (Figure 1). This extremely diverse landscape is situated in the world-renowned "Klamath Knot," a meeting of several mountain ranges forming a unique east-west/north-south confluence of botanical and climatic influences. Throughout geologic history, this area has served as a haven for plant species during alternating cycles of placation and inland flooding which inundated much of the available habitats throughout the region. As a result, the Applegate watershed hosts species whose native ranges extend from Alaska to central California. The area has been recognized by the International Union of Concerned Scientists as one of the critical bio-reserves on the planet.

Figure 1. Location of the Applegate Partnership Project Area

Ethnobotanical studies of the area indicate that the landscape which white settlers first encountered was already subject to consistent and intentional management by humans. Native Americans of the area regularly burned many portions of the landscape, often yearly, to foster and sustain both certain species valued for use, and for maintenance of open spaces conducive to hunting game.

Naturally occurring fires also had a major influence on the characteristics of the watershed. Studies suggest that low-intensity fires swept through much of the area as often as every 10-15 years. The frequency of these fires kept fuel loads at a minimum, and encouraged more open, park-like stands of large trees.

The past 120 years have dramatically altered this landscape. Years of intensive timber harvest, fire suppression, intensive agriculture and ranching, mining activities, and a decade of drought have dramatically altered the composition and structure of this area's forest from the conditions found by the first Euroamericans in the area. A patchwork of ownerships, private and public, fragment much of the landscape into holdings ranging from a few acres to over 100,000 in the case of national forest land.

SOCIAL SETTING

The first Euroamerican settlement of the Applegate Valley took place around 1850. Fueled by the discovery of gold, Jacksonville, Oregon was the center of Oregon's population in 1850. The settlement patterns and land-use behaviors of these early arrivals are characteristic of pioneer species. They rapidly established an infrastructure based on voracious and inefficient consumption of resources. Most new arrivals intended to stay only long enough to make their riches and move on.

This strategy created major impacts on the native biological, geographic and social constituents of the area. The indigenous populations of humans, the Takilma and Dagilma peoples, were largely exterminated or relocated by 1870. Human-set fires designed to remove forest cover dramatically altered the forest conditions throughout much of the watershed. A Portland paper in 1870 reported that smoke from fires in southern Oregon was so pervasive that it disrupted shipping on the Columbia river 300 miles to the north. Hydraulic mining further altered the land forms and dramatically impacted both the soils and vegetation of the area, and the hydrologic patterns of the landscape.

Eventually the major mining activity began to play out and the area settled into a typical western pattern of subsistence farming/ranching. This land-use and social pattern characterized the area until the early 1960s when the marginal operations began closing down, creating opportunities for new immigrants to purchase land. This opportunity corresponded to the larger back-to-the-land movement which was taking place throughout the Northwest. As a consequence, this period saw a new set of immigrants arriving in the valley with many significant cultural and educational differences from the pioneering society then pervasive in the watershed.

Despite these differences, the strong common identification and appreciation of active subsistence use of the landscape formed viable cultural bridges between these two groups. Preister (1994) notes that it was common to find these two groups mixing in social settings and institutions such as volunteer fire departments or weekly evening card games held at a local cafe. However, important differences did exist, and these were about to surface as industrial management of the surrounding lands began to take shape on federal forest lands.

TWO DECADES OF GROWING CONFLICT

Logging has been a prevalent activity in the Applegate watershed since arrival of the Euroamerican settlers. During the early to mid 1900s, small sawmills could be found up

almost all of the major tributaries to the Applegate River. However, most of the logging practiced in this period was selective logging in which the largest and most valuable trees were felled and removed, leaving a substantial portion of the residual stand intact. In the 1960s, these selective cutting practices began to be replaced by more intensive forms of extraction utilizing clearcutting and slash burning. These practices had far more significant impacts on the landscape and were much more visible to area residents.

During the late 1960s and early 1970s, grassroots environmental concerns over large-scale clear cutting and herbicide applications sparked the formation of local watershed associations which began challenging the long-standing patterns of resource extraction and use. These concerns were particularly strong among the newer arrivals to the watershed. By the mid-1980s, such challenges had grown into major battles between local environmentalists and the federal agencies managing approximately 70 percent of the watershed's forests. Most of the timber sales in the area were appealed, and many were blocked.

In 1990, most planning of new logging activities in the area was halted by the federal court injunctions pertaining to the spotted owl.

GENESIS OF THE PARTNERSHIP

In the spring of 1992, a local environmentalist, Jack Shipley, began talking to agency scientists and an industry research group about the possibility of developing a landscape-scale management plan which would attempt to demonstrate the concepts being developed in what was loosely defined "ecosystem management." Shipley proposed to several leading scientists including Jerry Franklin that the Applegate watershed, an 800 square mile basin in southern Oregon, would be a perfect testing ground for this approach.

Based on the enthusiastic response from Franklin and others, Shipley began making presentations to a variety of agency groups in the Forest Service and BLM throughout the summer and early fall of 1992. Through the connections open to the industry group, the Aerial Forest Management Foundation[1], Jack and others were able to give presentations to the head of Region 6 (covering Washington and Oregon) of the USFS and eventually to the state director of the Oregon BLM. The positive feedback they received confirmed the timeliness of the idea. What remained was the development of community support.

Throughout the spring and summer of 1992, Jack began circulating a concept paper among a wide variety of local interest groups including industry and the environmental community. The paper outlined overarching goals for management of the watershed, namely forest and community health, and served as a means of determining whether common ground existed in philosophical orientation among the diverse and sometimes warring factions affecting the fate of the Applegate watershed. Comments were collected and the draft revised until it appeared that an overall consensus on basic principles actually existed.

In October of 1992, Jack hosted a gathering at his home in the Applegate. Over 30 people gathered on the back deck of Jack's house to share a potluck dinner. A wide range of backgrounds and affiliations met that afternoon to talk about the possibility of joining together to develop a community-based solution to the timber crisis.

A unique part of this gathering was the format of the initial introductions. As everyone went around the circle introducing themselves, they were asked to tell something personal about their background, their past times, and their experiences in the forest. People were asked specifically *not* to talk about who they worked for or of what group they were a part. As a result, loggers talked about their love of hunting and fishing with their grandkids in the "woods," and environmentalists spoke of their concern for the traditions and culture of their small rural communities. A distinct sense of the common concerns emerged which led to an agreement to form a working group to move forward in developing a joint management plan for the 500,000 acre Applegate Watershed.

In an effort to create a broad-based representation of the various interests present in the valley, the group attempted to find representatives from the following groups or interests: farming/ranching, timber industry, watershed groups, environmental organizations, and agencies (BLM and USFS).

This core of people eventually galvanized into a nine-member board which called itself the Applegate Partnership. The group started meeting twice weekly in November and December of 1992. During December the group hosted a meeting with the Regional Forester from USFS Region 6, John Lowe, and the state head of the BLM, Dean Bibles. As part of the tour, board member Dwain Cross, owner of a helicopter logging company, took the two agency heads on a helicopter tour of the watershed. Afterwards, the agency directors met with the Partnership board over a potluck lunch at the home of a local resident. As a result, both agency heads agreed to endorse and authorize their local offices to actively participate in the Partnership's activities.

KEY DEVELOPMENTS

Throughout the late winter and early spring, the board worked to create a mutually agreed upon approach for identifying potential projects in the project area, and to facilitate their implementation. Several mistakes were made during this period, including underestimating the potential threat which the Partnership's activities represented to the existing agency personnel responsible for managing lands in the project area. Concern soon began to emerge over whether the Partnership was trying to take over the management role from the agencies. This conflict led the board to reassess its role and strategy. Rather than attempt to design its own projects

[1] The Aerial Forest Management Foundation (AFMF) was founded in 1991 to conduct research and development on helicopter-based logging systems. From the outset, this group was a leader in promoting new approaches to selection-based logging techniques which retained forest structure and ecosystem integrity. The group was originally funded through congressional appropriations and designated as a partner in the Forest Service's Pacific Northwest Research Stations "New Perspectives Partnership," a research effort designed to examine new approaches to forest management. This association gave AFMF direct access to many of the high-ranking officials in Forest Service Region 6.

in the watershed, the Partnership invited the agency staff to bring forward projects which would meet a set of ecosystem-based criteria that the board had developed.

During early spring, prospects for the upcoming Forest Summit caused a new flurry of activity as rumors circulated that one or more of the Clinton Administration's cabinet might come to tour the project area and meet with the Partnership board. Eventually, Secretary of Interior Bruce Babbitt did spend a day touring the area and met with the Partnership board in the same private residence previously used to meet with the agency heads. Following the meeting, Babbitt made several statements to the local and national press strongly endorsing the Partnership and calling it "historic effort." Two Partnership board members, Dwain Cross from Croman Corporation, and Jack Shipley, were invited by Babbitt's staff to attend the Forest Conference as the Secretary's guests. The Partnership was subsequently mentioned during the conference as one of the examples in the region of a locally generated solution to the timber crisis.

As a consequence of this exposure, President Clinton's Forest Plan identified the Applegate Partnership as a model for community-based forest management. Of the ten sites the Plan designated as Adaptive Management Areas, only three have partnership efforts in progress, and only the Applegate Partnership has formulated a clear plan to address both ecological and economic issues.

OVERALL PARTNERSHIP STRATEGY

Early in the process of identifying its overall objectives, the Partnership board identified three primary task areas necessary for developing and implementing a community-based ecosystem management plan. These tasks areas are: ecosystem assessment and formulation of a monitoring plan; community skills and resources inventory and development of an information and feedback system to facilitate community participation; and development of new implementation mechanisms to enable local land managers to help generate more economic opportunities in the local community. These task areas are as follows:

1. **Ecosystem Assessment**. Developing a natural-resources inventory which addresses the entire ecosystem requires a scientific team which includes agencies, non-agency specialists, and representatives of key interest groups such as the environmental community and industry. The Applegate Partnership initiated the formation of such a committee. A core group, consisting of an ecologist, forester, hydrologist, and restoration specialist met for six months to lay the groundwork for a larger planning team consisting of a wide range of specialists including both scientists, agency planners, and representatives of both industry and the environmental community.

The initial information needs assessment for the ecological evaluation was completed nine months after the group was convened. The document, however, simply profiled the information which would need to be collected to formulate such an evaluation. Without the larger landscape assessment the Partnership had originally envisioned, its claim to be moving forward in supporting an ecologically-based management plan for the watershed carried little credibility.

Eventually, in frustration over the agencies' (BLM and USFS) apparent unwillingness to commit the necessary resources to conduct such an analysis, the Partnership board — including environmental, industry, and community members—met with the two Forest Supervisors and BLM District Managers responsible for land in the watershed. Board members strongly protested the agencies' lack of follow-through and clearly stated that if the agencies were unwilling to commit to such an assessment, the Partnership would disband and leave the agencies to deal with the return of interest- group politics.

Within three weeks the agencies had appointed a joint team of specialists to conduct an overall ecosystem-health assessment. This team met together for over two weeks and eventually published a report identifying the key issues and ecological concerns of the Applegate watershed.

2. **Community Assessment, Inventory, Involvement, and Monitoring**. Concurrently, the Institute and the Partnership initiated a process to assess, inventory and monitor the issues and resources among residents in the project area. The first step in this process was a community-impact assessment which utilized informal outreach techniques to identify the major interest groups in the area and their key issues. During this process, key gatekeepers and caretakers in the community were identified and a communication network established to provide rapid feedback about proposed or implemented projects.

During this process, the Institute also conducted an inventory of the existing size and capability of the local workforce. The Applegate watershed hosts a population of over 9,000 residents, over 10% of whom work in some sort of forest-products-related industry. Using a combination of public meetings and personal interviews, the Institute assessed the present KSA (Knowledge, Skills, Abilities) set among the existing workforce. By comparing this set of abilities to the set of skills which will be required under the projected set of ecosystem-management activities, the Institute is beginning to determine what sorts of skill-enhancement and training opportunities will be necessary to involve local workers in management of the watershed. This will in turn allow the local community college, county extension, and agencies to develop training programs tailored to the local need.

The Institute has already initiated a training program in forest inventory and assessment skills targeted toward displaced workers in the Applegate and two other forest-dependent watersheds in the Rogue Valley. Two other training programs, one in restoration techniques and the other in forest-stand improvement activities, are slated for implementation in early 1995.

Through ongoing collaboration with resource planners, community-development practitioners like the Institute and the Partnership will be able to make projections about the longer-term workforce size and skill levels necessary for ongoing ecosystem maintenance and enhancement. *This proactive forecasting of ongoing labor requirements in ecosystem management will allow, for the first time, a capacity for adaptive and orderly change within the workforce.*

Finally, based on the indigenous information-transmission patterns and predominant methods of interaction in the

community, the Partnership is developing a series of communication tools such as video updates, newsletters, and public gatherings to maintain and enhance direct community involvement in the activities facilitated by the Partnership. Using the network of contacts developed during the community impact assessment, the Partnership can also monitor the communities' response to proposed or implemented actions. This facilitates early and timely response to emerging issues and minimizes the potential for disruption of activities caused by distortions of information or unrecognized concerns.

Preister and Kent (1981) place issues on a continuum ranging from "emerging issues," to "existing issues," and finally "disruptive" issues. In an issue-management system, the goal is to identify and address issues in the emerging stage before they become entrenched and intractable. By the time issues have gone unaddressed long enough to become disruptive, they are extremely difficult to resolve without substantial investment of time and resources.

3. **Locally-based Implementation**. Perhaps the most economically important influence available to the federal government for benefiting rural communities is the mechanism by which it implements forest management. During the contracting process, the resource inventories and opportunities meet the availability and capability of the workforce. This process is also one of the most effective ways to create substantive opportunities for local people to participate directly in the implementation of management activities, either in traditional resource-related activities, or in monitoring and research. These opportunities for direct involvement build participant awareness and expertise in local resource management and foster the emergence of a local stewardship culture.

The key missing element is the development of new implementation mechanisms which directly join the resource tasks and opportunities and the existing local workforce. In an effort to find mechanisms to direct more work to local resource workers, Partnership board members are meeting with contracting specialists from the agencies to discuss new approaches to contracting that would enhance local resource workers' access to employment opportunities in their area, and create longer-term contracts which offer more security and consistency. The development of training programs targeted at local- community resource workers also maximizes the likelihood that those living in the area will have a strong competitive position in bidding on agency contracts. The agencies will need to value these skill-enhancement initiatives by providing contract processes that favor those with demonstrated proficiency in ecosystem management.

These three elements, ecological assessment, community assessment, and local implementation form the basis of the Partnership's strategy and the core of its efforts in the coming year. Figure 2 illustrates these elements of the Partnership's community-forestry approach.

KEY ELEMENTS IN COMMUNITY-FORESTRY STRATEGIES

Based on the experiences described above, and communication and observations of other community-based forest management efforts in the region, I have identified the following five elements as important areas for consideration in the development of community-forestry initiatives. These elements include: forming multi-interest partnerships; conducting comprehensive ecological and community assessments; creating and sustaining vehicles for substantive community participation in all phases of forest- management decision making; developing mechanisms for community-based implementation of forest-management practices; and building coalitions with other community-based efforts in other areas.

BUILDING LOCAL PARTNERSHIPS

A key consideration in attempting to implement a community-based forest management which successfully addresses both ecological and socio/economic/cultural concerns is the size of the land base under consideration. The land area chosen for management must be large enough to address driving ecological considerations (e.g., watershed condition, wildlife patterns, forest health), as well as provide significant economic opportunities for local residents.

As project area size increases, the number of potential stakeholders in that area also increases. In the current setting of environmental litigation over the spotted owl and other endangered species in the Northwest, these stakeholder groups are often clearly visible, and openly antagonistic to one another.

The first step in developing a community-based, forest-management approach is to identify the key stakeholder groups which have the capacity to substantially support or impede such an approach. In most instances, any significant plans for forest management will require the support of these key stakeholders, or be subject to lengthy delay or obstruction.

The second step in building cross-interest cooperation is to launch a series of informal contacts with each sector or interest group. This allows organizers to both identify the key issues of concern, and determine who the potential spokespersons are among the group. These spokespeople must be recognized as legitimate within their respective groups.

Generally, informal dialogue begins among the various spokespeople from each interest before any formal gatherings take place. In many instances, some agent who is broadly perceived as neutral begins this dialogue by having separate conversations among the various interests and conveying the issues in a sort of folk-diplomacy.

Eventually, a gathering of interest groups takes place. These initial gatherings are often relatively unstructured and informal, and are highlighted by story telling and accounts of personal history. In the initial gathering of the Applegate Partnership, a group of 60 people gathered outside on a wooden deck—consisting of environmentalists, agency personnel, community residents, and industry representatives—were asked to introduce themselves and tell about their family and personal histories without telling who they worked for.

If the initial group agrees to form a partnership, the next step is selecting the representatives for each interest group. This is a critical step and may be one of the most important determinants of success or failure. Whaley (1993) describes

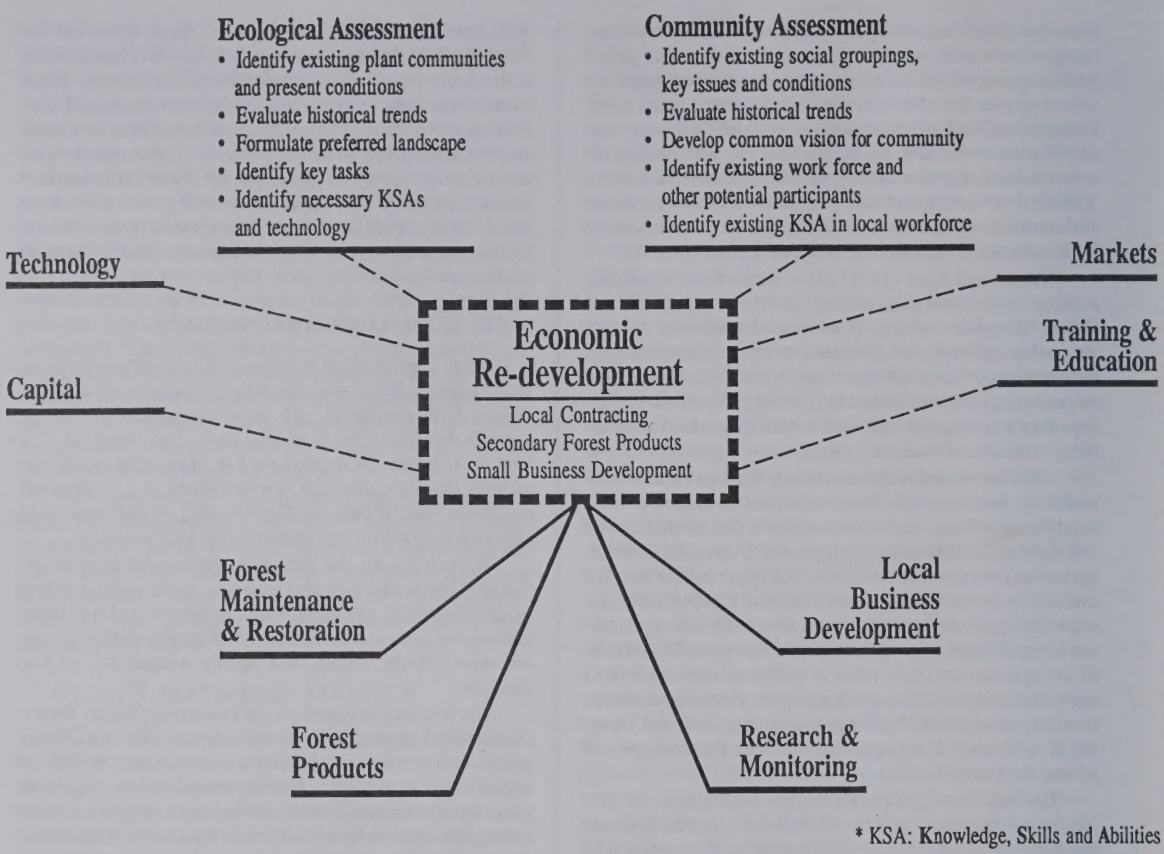
Ecological Assessment
• Identify existing plant communities and present conditions
• Evaluate historical trends
• Formulate preferred landscape
• Identify key tasks
• Identify necessary KSAs and technology
Community Assessment
• Identify existing social groupings, key issues and conditions
• Evaluate historical trends
• Develop common vision for community
• Identify existing work force and other potential participants
• Identify existing KSA in local workforce
Technology
Capital
Markets
Training & Education
Economic Re-development
Local Contracting
Secondary Forest Products
Small Business Development
Forest Maintenance & Restoration
Local Business Development
Forest Products
Research & Monitoring
* KSA: Knowledge, Skills and Abilities

Figure 2. Elements of the Applegate Partnership's community-forestry approach.

three critical elements for successful partnerships. The first is recognizing that successful partnerships are based largely on the strengths of the individuals who participate rather than the organizations represented. For partnerships to succeed, participants must be able to both disagree and yet still work together.

Whaley's second principal is that participants must see that they are unable to accomplish alone what they can achieve as part of a partnership. This is the glue that binds a group through the difficult, initial phases of building trust and identifying common goals and objectives. Collectively identifying both desired future outcomes and worst-case scenarios is an important part of the initial partnership-building process.

Finally, according to Whaley, partners must be clear about what they and every other person in the Partnership "bring to the table." By understanding what resources, skills, interests, and limitations each partner carries with him/her, the Partnership can more realistically assess its capabilities and the factors it can or cannot influence.

It is very important for the Partnership group to clarify its role in relation to the community-based initiative being conceived. For example, a partnership group will not likely be given broad decision-making prerogative over either public or private lands. Similarly, the Partnership group cannot feasibly take an overly active role in reviewing and monitoring all of the land-management or community-development activities in the project area. Consequently, the Partnership group needs to define its function clearly. In most cases, a partnership's major role is to lobby its interest group to support a community-based approach, and to secure the resources necessary for implementation. In essence, *the partnership acts to create an open space in which community-based planning can take place unobstructed by forces outside the project area.*

CONDUCTING COMPREHENSIVE ECOSYSTEM ASSESSMENTS AND COMMUNITY-RESOURCES INVENTORIES

Comprehensive ecosystem-management planning requires the consideration of both ecological and social/economic issues. Consequently assessments of both are essential.

1. **Ecosystem Assessment**. Using a process similar to the one described for the Applegate Partnership, a group of

scientists and interest-group representatives develop a comprehensive assessment of the primary ecological dynamics shaping the area under consideration. This assessment is then used to identify the ecological priority areas in need of attention, and the opportunity areas in which forest products can be produced as a part of the activities designed to enhance ecosystem health. A part of the team needs to collate these opportunities for both short- and long-term timeframes, and begin building projections for the amount of labor necessary to complete the tasks identified, the types of skills necessary, and the potential flow of forest products which will result.

2. **Community Resources and Skills Inventory**. Concurrent with an ecosystem assessment of the community's surrounding resource base, organizers should conduct an inventory of the existing size and capabilities of the local workforce. As part of this inventory, the team should also conduct an accounting of the technology and resource-management-related information available to this workforce. Special attention should be given to assessing whether these resources are truly accessible to the workforce: e.g., can they afford it, are they trained in its operation, is the information they need packaged in a form that is accessible to them, etc.? Most forest-dependent areas continue to have a high percentage of their workforce with some sort of forest-products-related industry experience. *In order for these assessments, both ecological and community, to be relevant and vested in the community, it is essential that community residents are given the opportunity to participate and jointly direct these studies*. A project advisory committee with broad-scale community representation would be an excellent mechanism to insure this participation.

FOSTERING SUBSTANTIVE COMMUNITY PARTICIPATION

Even if a partnership board has carefully constituted itself to include community representatives, this does not insure that the community will be, or will consider itself, adequately represented in the various phases of planning and implementation. While it is essential for key interest groups to be represented in order to minimize outside disruption of a community-based, forest-management approach, ample opportunities still remain for local dissent and challenge. Communities must be given the opportunity to identify what their goals are as part of the community forestry process. This means communities must be given a direct role in defining what constitutes community well-being and how it is measured.

1. **Community Well-being Assessment**. As noted earlier, an essential question which must be answered in defining community well-being is the extent to which the community has been involved in the assessment. In the majority of the studies cited (Fortmann and Kusel 1991; Lee 1990; Gramling and Freudenburg 1992), researchers established the criteria for assessment. Fortmann and Kusel (1990) actively recognize the importance and value of community-based measures of well-being. Their method of incorporating these considerations into their study was to conduct rapid rural assessments on a series of targeted communities. The utility of this approach is obvious. Researchers are able to avoid the fuzziness of community-generated criteria, many of which are highly subjective, and results are replicable and comparable between geographically disparate locations.

However, the academic research value in replicable community assessments may ultimately be less important than the pedagogical value a community gains from identifying and monitoring measures of its own well-being. As Willms and Gilbert (1991) point out:

> The definition of health as a resource for control over one's life suggests that the definition of a healthy community must mean that there is some control over the assignment of what it means to be a healthy community. Community control means that the selection of indicators and the interpretation of the data gathered must be directed by the communities themselves.

A community impact-assessment process (Preister and Kent 1981, Gramling and Freudenburg 1992) is a useful starting point for developing a well-being assessment. This model of community evaluation uses informal contacts and interviews to build a comprehensive map of interest groups within a community, the range of issues of concern to them, and the gatekeepers, opinion leaders and caretakers who anchor this informal social network. With this kind of broad-based assessment as a foundation, organizers can then develop a process by which the community itself identifies the criteria and measures for evaluating its own well-being.

As a starting point for providing a framework for a community-based, well-being assessment, I have collated a variety of well-being indicators using the studies cited above and other attempts to develop quantitative/qualitative measures of community well-being (Preister and Kent 1981, Mathur 1989, Willms and Gilbert 1991, Gramling and Freudenburg 1992). As a demonstration of the common challenges facing the understanding of both ecosystems and community systems, these criteria have been arranged using the same three categories derived for ecosystem assessment: composition, structure, and function (Figure 3).

In order for the establishment of community well-being measures to be meaningful, they must be monitored over time and the results given back to the community.

2. **Community Monitoring and Involvement**. Communities have had decades of experience with "public involvement" exercises which offered no real substantive opportunity for influencing agency or corporate decision making. Added to this legacy of bad experiences in public participation, many segments of the community are frequently excluded by traditional involvement exercises due to the class, gender, or economic barriers which are imbedded in the choice of involvement techniques.

In recognition of these challenges, effective community-based forest management requires a proactive community outreach program which can identify the primary value/interest affiliations which are present in the project community. As with major interest groups, organizers need to identify key opinion leaders or "gatekeepers" for these affinity groups and develop appropriate means of contact and communication. Much of this process is by nature conducted

in the informal sector; meetings in local restaurants, barber shops, grocery stores, or people's homes. As John McKnight (1987) noted in a discussion of community dynamics "In Universities, people know through studies. In business and bureaucracies, people know by reports. In communities, people know by stories."

This approach to community assessment has been well documented in the Social Impact Assessment literature (Preister and Kent 1981, Gramling and Freudenburg 1992). The important augmentation to the methodology recommended here is the establishment of an ongoing community-monitoring network. After the primary affiliation group representatives have been identified in the community, regular contact should be maintained with these people to provide for timely feedback on the communities' responses to projects being proposed or implemented. As one expert in community assessment pointed out, it is much easier to respond successfully to an issue when it is first emerging than wait for it to become established, embittered, and entrenched.

This commitment to community "monitoring" provides yet another parallel to the emerging principals in ecosystem management. Successful implementation of either forest-management or community-development strategies will require a much higher level of commitment and consistency to ongoing monitoring and evaluation than has ever been practiced to this point.

Any monitoring program established must also be accountable and accessible to the community, and consistently feed its results back to the community itself. Establishing a covert monitoring program with proprietary access is a recipe for disaster.

LOCAL IMPLEMENTATION OF ECOSYSTEM MANAGEMENT

As noted earlier, ecological assessment should be designed and implemented in a manner that identifies types and amounts of labor necessary to maintain and improve ecosystem health. By finding ways to direct these economic benefits locally, land managers can conduct forest management and rural development simultaneously.

Successful implementation of ecosystem management also requires a level of monitoring and evaluation never before attempted in natural-resources management. This demand for information and analysis far exceeds the capacities of the federal agencies as they are now constituted. The most logical mechanism for meeting these information needs is to directly involve the communities in collecting and interpreting of ecosystem data. At the 1993 Forest Conference in Portland, a number of the nation's leading researchers in ecosystem management, including Jack Ward Thomas, Jerry Franklin, John Gordon, and Chad Oliver, all noted both the need for more monitoring data, and the logical role for local communities in its collection and assessment. Several groups in the region have already begun developing third-party systems to monitor agency and industry activities. These programs use a mix of both contracted and volunteer labor drawn from communities adjacent to the lands being monitored.

This use of local labor has benefits stretching beyond simple economic returns. By involving local people in the actual resource management, whether by direct forest- management activities or monitoring, the level of experience and understanding of ecosystem processes expands in the community. This in turn builds the capacity among local people to participate actively and directly in more complex resource-planning and implementation tasks. In this manner, a rich stewardship culture grows which provides many benefits for both the local ecosystem and the local community.

In total, *implementation of forest-management tasks is the most powerful community-development tool available to the federal government.* However, to be successful, a number of standard agency practices will have to be modified. An excellent example is the present approach to contracting forest-management activities.

The traditional view of open bidding fails to recognize or account for all the hidden costs of letting work flow outside the community (e.g., unemployment payments, lost wages, community breakdown (domestic violence, etc.), loss of self-esteem, and depopulation of rural communities with resulting loss of a land-based lifestyle). Promising approaches with some track record include performance-based contracts, multi-task contract packages, and long-term stewardship contracts. A variety of groups are also developing contracting provisions which give preference to resource workers who live within a certain distance of the contract activity. This approach is reminiscent of the cutting circles originally proposed under the Sustained Yield Unit Act of 1944.

COMPOSITION
Cultural/ethnic diversity
Age class distribution
Income distribution
Immigration/emigration

STRUCTURE
Public infrastructure
Private infrastructure
Land Ownership Patterns
Environmental quality

FUNCTIONS
Community institutions
Public participation
Communication
Capital retention
Education
Health Care

Figure 3. Community Well-being Criteria

BUILDING REGIONAL COALITIONS

The political reality facing most forest-dependent communities that are considering a community-based, forest-management approach is the overwhelming momentum behind centralized, top-down approaches to resource management. This theme of outside ownership or control of local forest resources can be found throughout the region regardless of whether the predominant landholders are private companies or public agencies. Several initiatives like the Applegate Partnership in southern Oregon, the Matolius Partnership in central Oregon, the Quincy Library Group's efforts in northeastern California, or the Hayfork consortium in northwestern California have been able to gain some measure of freedom in pursuing community-based solutions due to the novelty of their initiatives, or the political influence of their participants.

However, for a broad-based movement toward community-based forest management to occur, communities will have to form alliances with one another to secure and consolidate the administrative and legislative support necessary to sustain such efforts. To influence policy on a national level, these alliances will have to stretch beyond one region to encompass community-based efforts in other resource-dependent areas. Various members of the Applegate Partnership have already begun developing this regional organizing strategy. The Rogue Institute for Ecology and Economy conducted a successful conference in late 1993 to bring together over 140 representatives from 14 communities around the region to discuss community-based forest-management strategies. Participants included members of most key stakeholder groups including environmentalists, timber-industry representatives, agency staff, resource workers and their spouses, and community-development practitioners.

In a related effort, members of the Partnership board began meeting regularly with a group of similar community-based partnerships, primarily in northern California, in an effort to identify common issues and barriers limiting community-based problem solving around resource-management issues. This group, calling itself the Lead Partnership Group, is currently planning a major national conference to foster a dialogue with the regional and national interest groups who have up to now openly criticized or worked to obstruct these community initiatives.

The Institute has also spawned a separate but related association of groups working on resource-based sustainable development options for rural communities in the region. Represented are 18 different organizations in southern Oregon and northern California ranging from environmental organizations to more traditional community-development institutions. The purpose of this group is to develop a mechanism and strategy for rapidly disseminating the information and expertise being developed by these various groups. The group has developed a unique set of agreements among the groups which has created a collaborative association within which groups are working to secure funding and coordinate project activity. This groups calls itself the Klamath Province Collaborative Learning Circle.

SUMMARY: FIVE ELEMENTS IMPORTANT FOR COMMUNITY FORESTRY ENDEAVORS

Drawing on the experience of the Applegate Partnership and other community forestry efforts in the Pacific Northwest, five elements emerge as important considerations for locally-based, forest-management initiatives:

1. The mix of interests affected by changes in forest-management policy necessitates a strategy of building partnerships among the various stakeholder groups.
2. Building and maintaining broad-based community support necessitates a substantial commitment to the development of effective community assessment, monitoring, and feedback mechanisms. These mechanisms should be directed and controlled by the community as much as possible.
3. Comprehensive ecological and community inventories are essential to develop a "big picture" view of the dynamics of the forests and communities under consideration. These inventories should also involve the range of stakeholders and include the best scientists and community-development practitioners available to insure that the information gathered is suitable for developing industrial restructuring strategies based on project volumes of material and labor needs.
4. New mechanisms for implementing forest-management activities need to be developed which can direct work to local resource workers. In this way, the quality and consistency of work necessary for effective ecosystem management can be maintained, and the economic and social benefits of the forest resource employment can be retained in the local community.
5. Long-term success of community-based forest management will depend on the development of a broad base of communities advocating for this approach to resource management. Without this base, political entropy will continue to favor centralized, top-down approaches to control of local resources.

POSTSCRIPT

Since the original composition of this work, the Applegate Partnership has experienced a number of difficult struggles in its efforts to promote community-based problem solving in resource-management communities. Though these challenges have come in different forms, I believe they can be summarized in one word: power.

As the public profile of the Partnership grew in 1993 and early 1994, it began to encounter growing opposition from the regional environmental groups. These groups believed that the Clinton administration's fascination with the Partnership and the subsequent inclusion of Partnership-like "Adaptive Management Areas" in the President's Forest Plan would lead to industry-captured, local-control groups in many areas around the Northwest. In part due to these pressures, the major local environmental group participating in the Part-

nership withdrew. Despite the ongoing participation of a number of influential Applegate valley environmentalists and their watershed groups, the local media and others portrayed this as a departure of the environmental voice from the Partnership table.

Similarly, the industry, though more outspoken local proponents of the Partnership, filed a lawsuit against the Forest Plan using the Federal Advisory Committee Act as the basis of its challenge. In brief, the industry asserted that by utilizing non-federal employees in the formulation of its Forest Plan, the Administration had violated this relatively obscure law which had rarely been invoked since its passage in 1972. According to Judge Jackson's eventual ruling on the issue, FACA states that the government may not meet regularly with any group of non-federal people in any manner which could lead to influence over the government's course of action. Jackson went on to warn the Administration that any further violations of FACA could jeopardize both the Forest Plan and the Health Care Plan.

The Administration's response was to order the formal withdrawal of agency personnel from the Applegate Partnership and other high-profile partnerships. A long period of negotiation then took place to search for a legal means by which the agencies could continue to participate. With Judge Dwyer's final affirmative ruling on the Administration's Forest Plan, the agencies have now signaled a growing willingness to maintain a more visible participation. The memory of their withdrawal, however, continues to qualify the Partnership's overall optimism for their unqualified support.

Taken together, these events signal important lessons for community-based collaborative efforts. They generally reveal the likelihood that when communities of place assert the right to sit at the decision-making table, they will encounter the resistance of communities of interest (e.g., environmental, industry, etc.) who have largely enjoyed the most influential role on policy and decision making over the past 20 to 30 years. It also underscores how current laws, both FACA and NEPA, tend to favor these interest groups over local communities who generally do not have the resources necessary to maintain the legal and political tools which can use such laws or administrative procedures.

For the Applegate, this will probably be a useful incentive to withdraw from the high-profile arena of influence trading and political maneuvering, and to return to build the base of power which will have enduring influence in the strugglethe community itself. The Partnership is currently broadening its efforts to include work with the agricultural and ranching communities to look at ways to address water and development issues, work with private landowners to address fire and restoration issues, and in the schools to build the next generation of participatory local problem solvers.

The stakes are high. Already in the Northwest, a variety of other more reactionary groups have formed and are growing rapidly. Many of these groups call for the complete dissolution of federal land management in favor of local control. Others have chosen to identify other races or ethnic groups as their targets for criticism or attack. Overall, the population both here and elsewhere is weighing which set of strategies it can use to address the growing sense of powerlessness and chaos which are so palpable in our public and private lives. We hope that all who are aware of these disturbing trends will work with us in trying to build positive and constructive alternatives that point us toward a more just and sustainable future.

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The Trout Creek Mountain Project, Oregon[1]

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Abstract

The Trout Creek Mountain experience is an example of how the land and the people can win by building bridges of understanding and common interest between concerned constituencies. Love of the land, its natural resources, and realization of a need for changing grazing practices to reverse the degradation of riparian areas were the common interests that caused environmentalists, ranchers, the BLM, the Oregon Department of Fish and Wildlife, and the U.S. Fish and Wildlife Service to work together to find solutions. The result was a new management plan that was biologically sound and had diverse public support—this is what ecosystem management is all about. The social-political factors which allowed all this to happen were trust and respect between constituencies, recognition of the problem by concerned publics who together asked federal participation in finding solutions, strong support by BLM through all managerial levels, keeping communication open between constituencies, and having one BLM person in the position of Rangeland Manager Specialist/Ecologist so that trusting relationships can be built. The lessons learned from this are that public citizens have the power and obligation to take responsibility for the destiny of private and public lands, and that success comes when diverse individuals in the public accept each other and work together to make a healthy land and community.

INTRODUCTION

Much of our personal effort the past 10 years has been spent building bridges between concerned urban environmentalists and longterm ranchers who depend on the land for their livelihood. Putting folks with different backgrounds and values together for the purpose of making positive change on the land a reality, is a slow, painful but rewarding process. The Trout Creek Mountain experience is an example of how the land and the people can win.

HISTORY AND BACKGROUND

Evolution of the Trout Creek Mountain Working Group began in June of 1988. The authors of this article and Wayne Elmore were invited by the Oregon B.L.M Vale District to give a talk to ranchers in the Trout Creek Mountain area of southeastern Oregon. The purpose of the talk was to give examples of how ranchers in the Prineville BLM District have been able to work cooperatively with the BLM to generate management changes that better the ecological health of the land.

The Prineville, Oregon area has been well publicized by Wayne Elmore, a BLM riparian specialist, who has presented his slide show talk all over the country and has become "Mr. Riparian," a well-deserved title. Wayne has worked out of the same area for 18 years. The dramatic results he shows on the Bear Creek watershed were possible because:

- Prineville district and area managers have been willing to take substantial managerial risks to benefit ecological health.
- The BLM-rancher grazing advisory board has provided financial and positive peer pressure support.
- The range con (Earl McKinney) stayed in place and built trust and credibility with ranchers. With that trust and credibility he was able to negotiate and implement very non-traditional, biologically sound grazing strategies that produced watershed and riparian improvement.

Enough on the history of the Prineville program. Let's get back to the sensitive and fragile Trout Creek Mountain area and the June 1988 meeting at the schoolhouse in the tiny border town of McDermitt, Nevada. Picture the setting: one very angry manager of the Whitehorse Ranch, five other unbelievably frustrated ranchers, and several BLM folks including the area manager, range cons, wildlife biologists, and hydrologist.

Visualize "the mountain," which occupies nearly a quarter of a million acres of mostly BLM managed federal land in the southeastern corner of Oregon. Part of the mountain is in the Vale BLM District, part in the Burns district, and a small part of the south side is in the state of Nevada [Figure 1]. A majority of the area is in wilderness study, and is part of the Oregon BLM's top priority for wilderness designation.

This unique range of desert mountain country rises from a 4,000-foot base to a height near 8,000 feet. No evergreen trees grow in this rugged country, but many native grasses, shrubs, and trees thrive there. On top, the grass waves in the wind among the sagebrush and bitterbrush surrounded by patches of mountain mahogany. Aspen grow in the basins just off the top and continue in large scattered groves down numerous scenic, steep, rock-rimmed canyon walls. A suc-

[1] Editorial note: This paper is a verbatim transcription, with their permission, of a publication by Doc and Connie Hatfield entitled Trout Creek Mountain Working Group/1988-1993 with only slight editorial alteration to conform to Proceedings style.

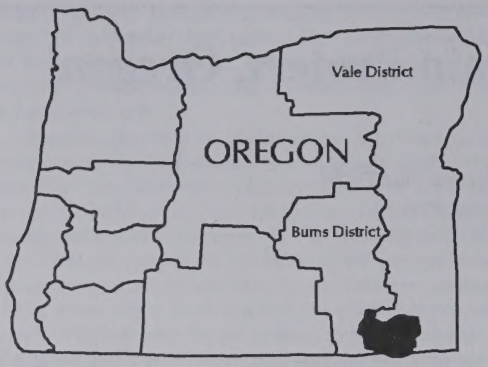

Figure 1. Trout Creek Mountain Project Area

cessful transplant of Bighorn sheep roams the mountain which also contains trophy mule deer, cougar, and sagegrouse to mention a few of the more "politically sensitive" wildlife species. Many small, wet meadows which are dry meadows during drought form the headwaters of several hundred miles of creeks which flow out to the flat desert floor. Willow, wild rose, and additional aspen make their living in the wet green areas (riparian zones) along the creeks.

The creeks are the source of irrigation water for the ranches which are scattered around the base of the mountain at the mouth of the streams. Most are family owned and historically have produced wild hay and some alfalfa on their flood irrigated meadows. Since settlement in the late 1800's, the cattle operations have been based on grazing the mountain in the summer, the flat desert in the winter, with the remainder of the feed requirements being met with hay. These ranches would be described in ranching circles as being well-balanced, natural, cow/calf range outfits.

Pastures on the mountain vary from several thousand acres up to 50,000 acres in size. Nearly all of them contain live creeks which support trout. Some of the trout are hybrids which resulted when the Nevada Fish and Game Department released Rainbow and Brook trout from the early 1930's through the 1950's to "improve" the fisheries. These "exotics" bred with the native Lahontan cutthroat trout and produced what has over time stabilized into a desirable game fish.

Several of the streams where the "exotics" were not released, or where a natural stream barrier prevented intermingling, still contain pure strains of the original Lahontan. It was in these streams in the Vale BLM district (home to the native cutthroat) where the primary land management concern existed. These remaining pure Lahontans are held in great respect by an increasing number of folks interested in wild natural ecosystems in general and wild trout in particular.

Ranchers in the area have been very aware of the uniqueness of these trout and had made efforts in the past by riding to keep their cattle off the creeks in the hot parts of the summer. However, in reality this did not prove to be very effective. Fencing was impractical due to the size and roughness of the country. Also, because it is a wilderness study area, new fences are nearly impossible to get approved. It is no wonder the ranchers were frustrated that June of 1988.

Likewise, it is no wonder that folks concerned about the native trout were frustrated. One critical factor for trout production is water temperature. Keeping water cool in these desert streams requires shade from grassy overhanging banks, willows, and aspen. Beaver harvest of willows and aspen coupled by cattle grazing of their sprouts and new seedlings had taken its toll on the tree population along the creeks for over a century. Besides providing shade, the willow roots are important to hold the banks together during floods. Finally, heavier concentrations of cattle in the creeks in late summer had caved off the overhanging banks. The result was warmer water temperatures and a marginal trout habitat.

Compounding the situation was a past history of "paper- and process-driven" BLM management. Couple that with a new range con on the ground every few years with never enough time to build trust and a true working relationship with the rancher permitees. Remember that for 21 years concern over riparian conditions and the fate of the resident trout had been a concern of the Oregon Department of Fish and Wildlife, numerous BLM resource professionals, and the Whitehorse Ranch itself. These concerns had been echoed by environmental organizations including the Izaak Walton League, Audubon, the National Wildlife Federation, Oregon Environmental Council, Oregon Natural Resources Council, Trout Unlimited, Oregon Trout etc.... Twenty-one years of environmental concern and frustration with *no significant change on the land.* No change that is except for a number of study enclosures which showed the potential of the riparian areas.

Viewed with a historical perspective, it is understandable why no change had occurred in grazing management. Cattle had been summer grazed on the mountain under open range conditions since the late 1800's, establishing an accepted tradition which was backed up by legally adjudicated grazing preferences. The BLM's primary role during the 1940's, -50's, and -60's was to license and administer these grazing permits. It was not until the late 1960's and 1970's that the importance of the environmental affects of grazing were clearly spelled out through environmental lawsuits and legislation. It was at this time that the mountain was fenced into several separate grazing allotments. However, the pastures were still very large, and the fencing in a number of instances actually concentrated cattle in the stream bottoms. Finally during the 80's, political appointees in the Interior Department sympathetic to the sagebrush rebellion frequently issued policies that were in direct opposition to the intent of existing environmental legislation. The BLM was caught in the middle, attempting to respond to a series of very conflicting signals.

Back to the scene being played in the small border town of McDermitt, Nevada that June of 1988. Wayne Elmore gave his 45 minute riparian talk in 2 hours. Angry discussion accompanied each slide, and the day ended with a number of talks, including Doc's, not given. There was not time to see how positive results had been accomplished cooperatively only 250 miles away. The frustrations of the past were so

prevalent in the room that the message would not have been heard anyway.

The next day was a tour on the mountain. The riparian areas had limited numbers of willow and aspen and most of those were old citizens of the tree world. The history was one of 130 years of continual livestock grazing from June to October each year. Even though one of the objectives of the massive Vale range improvement project of the 60's was to provide management alternatives to rest the mountain from continuous grazing, these alternatives had never been used.

At the end of the day, Connie could stand it no longer. As a "Public Citizen" she expressed her right to try and get some changes made that could benefit the land and the people. With substantial help from Bob Skinner, President of the Oregon Cattlemen's Association, and some friends in the environmental community, Doc and Connie were able to put together a meeting one month later at the 14th floor offices of the BLM State Director in Portland. Present at that first meeting of what would become the Trout Creek Mountain Working Group were:

Whitehorse Ranch (two representatives)
Izaak Walton League (two representatives)
Oregon Trout (one representative)
Oregon Cattlemen's Association (four representatives)
Vale District and Area managers
State Director
Chief of Resources and
Head of the Range Program statewide

The tension, energy, fear, care, and concern in that room for four hours was overwhelming. At the end of the day it was obvious that changes had to be made, or everyone, and the land, was going to lose big after a long battle in court. Regardless of the grazing decision made by District Manager Bill Calkins, ranchers or environmentalists were going to challenge it with a lawsuit. And under current procedures, while a lawsuit is in process, management reverts to historical precedent which would have meant several more years with no change on the ground.

FORMATION AND ACTION OF THE TROUT CREEK MOUNTAIN WORKING GROUP

Folks from this meeting in Portland with the addition of a representative from the Oregon Environmental Council and family member representatives from three neighboring ranches in the Trout Creek area became the "*Trout Creek Mountain Working Group*." The group's purpose was to see that change in management occurred *immediately* that would "*make a positive difference*" *on the land*. The future of the trout and the ranching community and culture depended on improving the health of the watershed and its streams.

The Trout Creek group, working closely with the Vale BLM and full support of the state director, was able to build enough understanding of the immediate need for watershed improvement that the ranchers involved voluntarily removed their cattle for a three year period of rest.

The Whitehorse and Oregon Canyon watersheds of the Trout Creek Mountain located in the Vale BLM district completed their third year of rest the fall of 1991. Despite severe drought conditions, the response of 100 miles of critical riparian area was encouraging. A lot of credit for the results needs to go to the Whitehorse management who recognized that the past 130 years of traditional summer long grazing on the mountain was not going to be acceptable in the future.

The Whitehorse ranch made a major financial commitment to the recovery of the watershed by leasing another ranch during this three year rest period and drastically changing their grazing program on the lower reaches of the watershed. Four neighboring ranches who also run cattle in the watersheds on the northeast side of the mountain made unprecedented management changes to rest their areas of use on the mountain. These changes involved considerable water hauling and 100 pound reductions in weaning weights. This weaning weight loss came primarily from grazing drifted up bunchgrass in August and September at four to five thousand foot elevation instead of the greener more nutritious bunchgrass and meadows at six to eight thousand foot elevation. The cattle were not short on grass, but its feed value was considerably reduced.

During this period of voluntary rest, the Trout Creek Mountain Working Group met regularly to help develop a solution for the land that included grazing. Some examples of the strength of a diversified working group follow.... Monte Montgomery (Izaak Walton League) has years of experience on the mountain and was invaluable in stimulating better communication between the Vale and Burns B.L.M Districts. Mary Hanson from the Oregon Environmental Council has a very logical mind and helped facilitate the meetings. She also communicated to other members the importance of doing everything in accordance with legally mandated public planning procedures. Kathi Myron from Oregon Trout's genuine care and love of the wild Lahontan, and the importance of its habitat, was a message she clearly communicated to everyone in the group. And because of Kathi and Oregon Trout's diligence and review, their protest of the first plan made it a much better document. The original document was vague on what acceptable condition of the streamside shrubs, trees, and grasses needed to look like in the future. Spelling out what was expected in ecological improvement assured trout habitat conditions and also gave the ranchers a clear goal to achieve. Because the plan received so much review, when the final decision was appealed by an out-of-state activist, the administrative law judge dismissed the appeal.

The District Manager from Vale issued a grazing decision for the Whitehorse Butte Allotment which became effective in late 1990. The grazing strategy was specifically designed for the benefit of the watershed and the fish which depends on that watershed for its existence. It is important to understand that the mountain received two years of voluntary rest before any formal grazing decision was issued for the Whitehorse Ranch. And although allotment management plans are in process for the four neighboring northeast slope ranches and two additional ranches on the south side of the mountain, formal grazing decisions for these ranches are yet to come. Despite the lack of formal allotment management

plans, these ranches are five years into a grazing program which has been reviewed by the U.S. Fish and Wildlife Service as being compatible with Endangered Species Act requirements for Lahontan Cutthroat Trout.

These results were only possible because environmentalists, ranchers, the BLM, the Oregon Department of Fish and Wildlife, and the U.S. Fish and Wildlife Service all worked together to find solutions for the land and people.

It was in the late spring of 1992 when the moment of truth and the test of three years of working together arrived. In the seventh year of the worst drought since the 30's, cattle were returned to the mountain to graze pastures containing endangered Lahontan cutthroat trout. Turning those cows out as planned demonstrated to everyone that the Vale BLM did indeed have the ability to follow through on a management program if it was biologically sound and had diverse public support.

The management strategy on the higher elevation mountain pastures is to graze from May to mid-July in an area for two years; then rest that area for two years. This program is based on the growth requirements of the plants and the social and eating habits of the cows. Willows and aspen do most of their growing after mid-July which is the same time when the bunchgrass is drying up and becoming less palatable. And like people, when the hills dry up and it gets hot, cattle find it more comfortable to congregate in the cool shade along the creeks. By removing the cows in the middle of July, new willow and aspen sprouts and seedlings are seldom grazed. The grass along the creeks, which was grazed in May and June, has time for full regrowth before fall. Since the bunchgrass on the hills is of excellent quality and palatability before mid-July, the cows spend less physical time on the streams and trampling of overhanging banks is minimal. The two years of rest which follow each two years of grazing allows the upland bunchgrass plants time to fully recover from being cropped at a sensitive time in their growth cycle.

This program is what ecosystem management is all about. The biological assessment of the management program written by Tom Miles, supervisory range con, was extremely thorough and accurate, which enabled the U.S. Fish Biologist to accept it. Bob Kindschy, wildlife biologist in the area for 37 years, deserves considerable credit for having the interest and foresight to have conducted monitoring baseline studies over the years which now are being used to scientifically document that ecological health is truly improving. There is no substitute for an interested biologist like Bob who has spent his entire career in the area giving him the experience to relate past management and hard monitoring data with the dramatic wet and dry cycles that characterize southeastern Oregon.

In September of 1993, after the mountain had received three years of rest and the cattle had completed the first two years of the planned four-year grazing cycle, a two day tour was conducted with the Trout Creek group. The U.S. Fish and Wildlife Service biologist directly responsible for the Oregon Lahontan program was satisfied with the results. Major positive documented changes on the land are a reality for everyone to see today. The streambanks now have sufficient young willow, aspen, and grass cover that the riparian system was able to benefit from a modest flood event the spring of 1993. And the prospect of the land becoming healthier in the future is a lot more than just some dream on paper.

Unfortunately, the traditional season-long summer grazing program on the Trout Creek Mountains that was in place five years ago is not that unusual in the West today. Most areas have not had as much public interest as the Trout Creeks. But the sad truth is too much ecologically unsound grazing continues to be licensed year after year with no changes.

There are several reasons for our current predicament in the West. Improving land management through laws and bureaucracy alone has not proven to be very effective. The BLM is a politically directed entity which has basically been paralyzed since 1974 from the conflicting messages and constraints it receives on a regular basis from Washington, D.C. and various lawsuits. This paralysis can be overcome through a consensus group such as the Trout Creek Mountain Working Group. When understanding exists between ranchers, environmentalists, BLM managers and resource professionals, state and U.S. Fish and Wildlife representatives, decisions that benefit the land and people can be implemented without years in court.

"SOCIAL-POLITICAL" FACTORS WHICH ALLOWED THE TROUT CREEK GROUP TO EXIST, FUNCTION, AND STIMULATE POSITIVE CHANGE ON THE LAND

- Trust and respect existed between a number of ranchers and environmentalists in Oregon prior to formation of the Trout Creek Mountain Working Group.
- The problem on the ground was recognized by both the ranching public and the environmental public who <u>together asked</u> the BLM to participate in a unique process to find <u>solutions</u>. Public land management agencies such as the BLM and Forest Service exist to serve the public's best interest. And to quote our Oregon State Director,

> "When a group of diverse interests with full participation by the Bureau of Land Management develop and support a sustainable resource management plan which is ecologically sound, economically feasible, and socially acceptable, it is extremely difficult for any individual or group to stop implementation of that plan." *D. Dean Bibles*

- Strong support existed at all BLM managerial levels throughout the process. But a key role of the joint rancher/environmentalist "public" involvement was making sure this support continued with each new manager. Over five years the Trout Creek effort included two state directors, two district managers, three area managers, and several interim managers.
- State Range Conservationist Chad Bacon was detailed by the State Director to maintain communication between the ranch community, the environ-

mental community, and the Vale BLM both at the management and on the ground levels. Chad's credibility and personal relationships with leaders of the Oregon Cattlemen, the participating environmental organizations, and local ranchers in southeastern Oregon was and continues to be an important key to the success of this pioneering group.

- A pilot "range specialist" classification is being tested in Oregon and Tom Forre, Rangeland Manager Specialist/Ecologist in the area for the past five years, has this position. The key in this new job description is that it enables range cons the opportunity to be *promoted in place* and become *responsible for land health rather than land products*. Tom has had this responsibility for five years now and has built trusting relationships, not only with the ranchers who depend on the land for their livelihood but also with environmentalists who depend on the area for their quality of life and the earth's future.

"Trust, respect, credibility and communication are four simple words to write. They are incredibly difficult items to build and maintain. But for lasting success on the land, they must exist."

THE PROCESS AT GROUP MEETINGS WHICH MAKES CONSENSUS AND ACTION POSSIBLE

Everyone sits in a circle and speaks in turn. A question starts each meeting such as... *"How do you feel about being here and what would* you *like to* help *make happen today?"* According to conflict resolution consultant Bob Chadwick, no one is at a meeting until their voice enters the room. By having to think about how you feel (most folks feel anxious and frightened which may be expressed as anger), the right brain is activated. The right brain is where our creativity is located.

Answering the question, "what would *you* like to *help* make happen today?" affirms that something is going to happen and you are going to be an important part of it. This is an empowering experience for the participants and changes the focus of the meeting from pointing out problems to developing solutions.

Ranch wives are specifically and personally invited to participate. Ranch men frequently are bound by tradition to the way it always has been which makes opportunities for change difficult to see. Women in general tend to be more right-brained and better able to understand the feelings of environmental folks who are viewing the situation from a much different perspective than the ranchers. Everyone's feelings . . . Ranchers, Environmentalists and Agency folks . . . have to be acknowledged before true consensus for change can occur.

After everyone's voice enters the room, two or three "opportunities in disguise" (more commonly known as "significant problems") are discussed. This is in the circle as a whole, or in smaller breakout groups, but always with each person given the opportunity to speak in turn and to be listened to with respect.

During the meetings of the working group, BLM representatives participate in turn as people with concerns and cares, not just as BLM employees doing their job.

Efforts of the group are goal oriented. The group's future "Big Picture" includes:

A. Baby Aspen, teenage Aspen, middle age Aspen and old Aspen, willows, trout, and wildlife throughout a watershed covered by a thick stand of vigorous perennial grass.

B. Baby, teenage, middle age and old ranchers and their livestock operating in an economically and ecologically sound manner.

There was considerable relief in the room when the ranchers had no problems working to achieve "point A," and the environmentalists had no difficulty with "point B." Descriptions for how the land needs to look throughout the watershed in the future were visualized by including statements such as, "*How McDermitt Creek looks now at the upper access, and how the upper watershed looks now at the head of Oregon Canyon.*"

At the close of each meeting, realistic commitments for accomplishing certain tasks and clearances are made by the ranchers, environmentalists, and BLM folks. The ranchers and environmentalists network with their peers to build understanding on what is occurring. The BLM's commitment prioritizes their work toward tasks that will make a difference on the ground. The BLM is presently buried under paperwork requirements without the staff or funding to accomplish those demands. For success to occur on the land, some sort of outside consensus pressure/support is required. Also it is critical that the State Director create an atmosphere in the state that supports working together and rewards positive change on the land.

The September of 1993 two-day Working Group Tour concentrated on looking at riparian areas which had been grazed in both 1992 and 1993.

Compliance in meeting the grazing objectives was 100%. The fate of the Lahontan trout appears in good hands. Ron Rhue, the U.S. Fish Biologist responsible for threatened and endangered species, was enthusiastically positive, not to mention greatly relieved, over the results on the land. The ranchers involved felt the working group experience has been a positive one even though the management changes have been very stressful and expensive, and the ranches capacity and annual profitability has been reduced. However, the bottom line is that a management plan that meets the criteria for endangered species in a wilderness study area provides a stable basis for a sustainable ranching operation in the future.

It takes people to improve land. We already have more laws and technical information than we need. Time is not on our side in the struggle to solve problems on public land. But the time is right for more "people-to-people" alliances where land owners, environmentalists, and state and federal agency folks work cooperatively to produce action on the ground.

Plain folks can make a difference, and it's exciting to see results like those on the Trout Creek Mountains.

LESSONS LEARNED

As "public" citizens we have the power and obligation to take responsibility for the destiny of the private lands we own and the public lands we depend on for many needs. Local communities can determine their own future. But the definition of "local" must be expanded to include not only the people who live in the area, but the people in urban areas who depend on that land for their quality of life and relation to a "natural" world.

Success on the land comes when a diverse group of interested "public" acknowledge one another as human beings and develop a vision for what a healthy land and community needs to be. The main obstacle is overcoming the frontier mentality we've lived on in the West for the past century.

The Flathead Basin, Montana

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Abstract

The Flathead Basin project began as a river-basin EIS, guided by a citizen-based steering committee which eventually evolved into the Flathead Basin Commission, a State-legislated body. Water quality has dominated the Commission's agenda, and has been the basis for assessing ecosystem change. Science has played a central role in providing information, driving adaptive management, developing an understanding of ecosystem structure and function, and informing the public. The ecosystem approach involved defining the system as the Flathead Lake catchment basin, synthesizing available information on the system with models, considering alternative management strategies, and making initial management decisions.

Flathead Lake is one of the 300 largest lakes in the world and among the top five in water quality. A 1983 algal bloom and declining summer O_2 levels in the late 80's signalled onset of nutrient loading. In vitro experiments showed phosphorus to be the major cause. In response, the Montana Water Quality Bureau, with state legislative concurrence, banned local sale of phosphorus detergents and facilitated upgrading of sewage treatment plants. Point-source release was reduced 15% with reduction in algal productivity. Non-point sources are still a problem and being explored.

A dam on the South Fork of the Flathead River, which altered the downstream temperature environment, was retrofitted to normalize tailwater temperatures. Based on project research, Federal Energy Regulatory Commission is considering changes in operations of Kerr Dam, located at Flathead Lake outlet, to reduce bank erosion from wave action. Based on discovery of a complex aquatic community of organisms in the Flathead River flow through the subsurface, geologic strata, the Montana governor and Secretary of Interior signed a Federal water-rights compact protecting surface and interstitial waters, and protecting clean-water flows into Flathead Lake.

Water quality of the lake in terms of the native food web has been permanently altered by human introduction of a non-native crustacean, Mysis, *which eliminated the native zooplankton; and by introduction of Kokanee salmon which eliminated the native westslope cutthroat trout, and the non-native lake trout which are suppressing the native bull trout, a candidate for threatened or endangered listing.*

In total, the Flathead Lake ecosystem research has placed science and management in proper human context through public education and debate, making possible adaptive changes in management actions.

INTRODUCTION

I am here to tell you about a long-term project to provide a scientific basis for conserving the natural attributes of the Flathead River - Lake Ecosystem in northwestern Montana, USA, and southwestern British Columbia, Canada. I intend to emphasize the role of science, but the project always has been very interactive with the human communities in the ecosystem. The work is rather unique, I think, because it has involved high-profile ecological science in grassroots decision processes.

The project is based at the Flathead Lake Biological Station, which was created in 1896, and is the second oldest biological field station in the United States. Since its creation, the Biological Station has been a point of reference for the scientific information needed to resolve conflicts over uses and abuses of environmental goods and services.

The main theme of this presentation is that credible science can provide information about how an ecosystem functions and thereby drive an adaptive- management process that in the long term will sustain the attributes of the ecosystem that the public values highly. I will show important ecosystem processes and responses and describe how that science was used as the basis for ecosystem management. Hopefully, this case history will illuminate the applicability of ecosystem principals in management of regional natural resources.

HISTORY AND EMPHASES OF THE PROJECT

The study got its main start in 1976 as a river-basin EIS. Funding was stimulated by a proposal for a large coal strip-mine in the British Columbia part of the basin; people were

very concerned about potential damage to environmental attributes of Glacier National Park and Flathead Lake (International Joint Commission 1988). A citizen-based steering committee determined how EIS money provided by the Environmental Protection Agency would be spent and what scientific questions posed by me and others would be emphasized in the initial studies.

In the mid-1980's, this steering committee evolved into the Flathead Basin Commission, which is a State-legislated body comprised of management agency heads in the basin plus an equal number of citizens. I am not a member of that commission. My role has been to provide the ecological information based on our scientific studies to the commission; whereas, the Commission sponsors forums and discussions of the science and policy implications, thereby allowing the public to be interactive on environmental matters.

I want to couch most of what I have to say in terms of water quality because water quality in this basin reflects not only the environmental variability of the system, but in many respects water-quality considerations integrate what many people perceive as quality of life. In every local survey in which people are asked why they like to live in Flathead country, they always comment on the high-quality waters, especially in Flathead Lake. Water quality has dominated the agenda of the Flathead Basin Commission and served as the primary variable for assessing ecosystem change. The role of scientists like me has been to demonstrate trends in water-quality indicators as accurately as ecological science allows.

For example, an important indicator of high-quality water is the native bull trout (*Salvelinus confluentus*). This fish is found only in clean, cold waters of the Pacific Northwest, such as Flathead Lake and its tributaries. I have a strong suspicion that this fish will be on the minds of a lot of people at this conference in the near future. It is likely to be listed under the Federal Endangered Species Act, or at least recommended for listing, by the Fish and Wildlife Service. It is an inhabitant of almost all of the streams and rivers in the upper Columbia River Basin where water quality remains near the pristine baseline. Throughout its native range, populations of bull trout are increasingly fragmented owing to habitat degradation by pollution, dams and negative interactions with introduced exotic fishes and other biota. The bull trout is declining in the Flathead catchment as a consequence of changes in water quality caused by human activities which I describe in detail below. Hence, the bull trout is a keystone species that serves as a barometer of the condition of water quality in the Flathead and elsewhere.

OUR ECOSYSTEM APPROACH

The primary scientific objective of our work at the outset in the early 1970's was to understand the distribution and abundance of animals, including bull trout, in an ecosystem perspective, and to conserve, if possible, the processes and responses that maintained ecosystem integrity (sensu Angermeier and Karr 1994). A key hypothesis has been that the critical ecosystem attributes are dynamic, constantly changing within a range of natural variation. Human activities always add additional environmental change. Indeed, in contrast to many talks at this conference, I have always thought that sustainability of any particular ecosystem state is probably mythical. Few natural resources worldwide have been sustained for any long period of time since the industrial revolution; environmental change is a given. The challenge is to manage renewable resources so that environmental change does not substantially degrade the quality of human life.

I will review our approach to long term documentation of environmental change in the Flathead in a series of steps that summarize what we've done over the years. And, when I say "we" or "our," I am referring to a long list of scientists, managers, politicians, and citizens that participated over the years in the research and ensuing debate of the implications of the results for public policy.

The first thing we did was define the ecosystem as the catchment basin of Flathead Lake. These boundaries were established in part because our keystone species, the bull trout, lives in the lake but spawns, broods, and smolts in the tributaries. Moreover, it was apparent at the outset that the high quality of water in Flathead Lake resulted from the fact that the land-use activities in the catchment basin had not significantly degraded the lake's tributaries. The lake is, in many respects, simply a wide spot in the river. Later, we acknowledged the "open" nature of the ecosystem and included the airshed and outlet river as key components of the ecosystem.

In retrospect, I think we implicitly embraced a unifying general definition of "ecosystem": the totality of ecological, social, and economic processes (function) that interconnect organisms (structure), including humans, with their environment within the Flathead River Basin and during a given period of time (ca. 1975 to date). We intentionally started large in scope, and worked down in scale to solve problems.

The second thing we did at the outset was to synthesize what we knew about ecosystem structure and function, and formally published it in the peer-reviewed literature. Periodic synthesis of existing knowledge is essential in regional ecosystem analyses. Often mathematical models are used to synthesize processes and responses that are important to managers. We have used mathematical and statistical models extensively to understand biophysical controls on Flathead water quality; we used models to formalize what we knew and to examine uncertainties, not to predict the future.

Next, we proposed various alternative management strategies and assessed uncertainties about them. In doing so, we were concerned about law, ecological theory, and whether a management hierarchy existed that could implement a management recommendation. Keep in mind that this was an interactive process that involved scientists, like me, national forest and park administrators, Native American and other community leaders, and informed citizens. We always had a great deal of concern about the degree of understanding of the science on the part of the general public, and believe me, after years of dialog about water quality and associated variables, a large share of the public can indeed converse accurately about the limnological phenomena in Flathead Lake.

We soon realized that some decisions had to be made and actions initiated even though our empirical knowledge of ecological processes and responses too often was incomplete.

So, we took some chances early on and said, "Well, here's what we know and there are a number of uncertainties in the science, but let's get out there and do what appears to be the right thing and determine empirically what happens." I'll show you some examples pertaining to water quality below. In some cases, clearly the management actions were misguided. But, in several cases the actions were smashing successes based on the data collected to date. Most importantly, since our water-quality data have been systematically and accurately collected over a 20-year period (coupled with less complete information back to the inception of the Station in early 1900's), actions could be evaluated along the way and adaptively changed as indicated by the data. I can't overemphasize the power of such long-term databases.

Throughout the years, the public made us scientists be accountable for the accuracy of our data and recommendations. This was especially true when we recommended that we ought to have a regional ban on the sale of phosphorus-containing detergents to protect water quality. The detergent industry, which of course was opposed to local controls on the sale of their products, came into the Flathead and said these local scientists don't know what they are talking about. Contentious public debate ensued. But, we were able to clearly demonstrate that water quality in Flathead Lake in fact was deteriorating as a consequence of input of phosphorus and nitrogen from urban sewage-treatment plants in the basin. The most expedient and cost effective way to reduce the nutrient load was to limit phosphorus-containing detergent use, while sewage-treatment plant technology in the basin was upgraded. In the end, the public endorsed the recommendation over the howls of industry and today the phosphorus load from sewage-treatment plants has declined by 15 percent and algal productivity in Flathead Lake has declined to near baseline conditions (Stanford et al. 1994a). Without question this would not have happened without a sound science rationale for the recommendation coupled with resounding public endorsement of the implications of the science. That endorsement was possible because of the interactive nature of the research and management process as mediated by the Flathead Basin Commission.

THE FLATHEAD RIVER-LAKE ECOSYSTEM AND ITS EXCEPTIONAL WATER QUALITY

Flathead Lake is one of the 300 largest lakes in the world. Of those 300 that occur in temperate regions of the globe, Flathead Lake is among the top five in terms of water quality. It is slightly larger than Lake Tahoe, but not nearly as deep. Flathead Lake now has better water quality than Tahoe, largely because so many more people live in the Tahoe basin (Naiman et al. 1995). Flathead Lake is so clear that in the fall you can lower a dinner plate, which we call a secchi disk, into the water column and see it 15 meters below the surface of the water. Many shoreline residents drink the lake water without treatment. Flathead Lake is indeed a very special resource for Montana, the United States, and the world.

But, three interactive problems threaten the high quality of water in Flathead Lake. One is nutrient pollution, phosphorus particularly, as noted above. Secondly, a dam on the outlet of the Flathead Lake and a hydropower reservoir (Hungry Horse) on the South Fork of the Flathead River partially determine the way in which water moves through the ecosystem and thereby influence flux of nutrients and other materials through the ecosystem. And third, we have suffered the consequences of food-web change caused by introductions of exotic biota.

These three interactive processes are the centerpieces of land- and water-use management in the Flathead and illustrate the utility of basic research as a focal point for citizen input to management processes at a regional scale.

FIRST SIGNS OF NUTRIENT ENRICHMENT

As noted above, in 1983 we had a lake-wide bloom of a pollution alga called *Anabaena flos aqua*. This alga is very distinctive and is not mentioned in any of the Biological Station analyses dating back to 1900. So, we were quite sure that it was a new wrinkle in the lake, very likely related to accelerated nutrient loading. Moreover, since 1977 we have continuously monitored species composition and production of algae in Flathead Lake. The long-term trend has been increasing production, apparently in relation to accelerating inputs of nutrients from human sources. In the late 1980's, one of the bays in the lake began to experience a decline in oxygen near the bottom in late summer, a classic indication of chronic change associated with too much algal growth in the water column. The overall implication of the science was that the lake was approaching a threshold of change that would considerably alter quality of life.

So, here were scientific data that early on showed us we probably had a problem. What did we do about it? First of all, we shared the information with the community through the Basin Commission forums and other public activities.

At the same time, we wanted to reduce uncertainty surrounding what we knew about the problem. The first thing was to determine whether nitrogen or phosphorus was causing the algae to grow excessively. So we initiated a set of experiments and found that we got a growth response from phosphorus during most of the year and from both phosphorus and nitrogen in the late summer. We also showed that grazing of algae by zooplankton was much less influential on total algal production than limits imposed by lack of phosphorus.

But this conclusion was based on experiments in bottles. Did it also hold for the real-world environment of the lake? Our detailed, long-term field data showed that phosphorus coming into the lake was largely contained in the Flathead River, which is the predominant tributary of the lake. However, we also were able to show that most of the urban sewage and non-point nutrient loads enter the river upstream of the lake. In summary, we were able to separate natural and human sources of variation in the nutrient supply from the catchment to the lake via the Flathead River. In terms of relative flux, phosphorus input was likely to cause a greater algal growth response than nitrogen, corroborating the *in vitro* studies.

We also showed that a large amount of phosphorus enters the lake annually from the airshed, mostly from wood smoke. Shoreline inputs of nutrients from septic systems also was

demonstrated but the volume was minuscule in relation to river and airshed sources.

Based on these data, the Montana Water Quality Bureau recommended actions be taken to reduce the amount of phosphorus and nitrogen loading that was occurring in the system (Water Quality Bureau 1984). Owing in large part to the public education forums by the Flathead Basin Commission, the recommendations were endorsed by the Montana legislature in the form of a local-option ban on sale of phosphorus-containing detergents. And a sequenced upgrading of all sewage-treatment plants (STP's) in the basin to include nutrient removal was facilitated by the Montana Water Quality Bureau and the US Environmental Protection Agency.

Today we have reduced the point-source problem by about 15 percent. Prior to this action, the phosphorus load from the plants was about 20 percent of the annual load coming into the lake. Algal productivity declined dramatically in apparent relation to these management actions (Stanford et al. 1994b). However, concern exists about these improvements being offset by non-point or diffuse sources of nutrients related to forest harvest, agriculture, and air pollution. We are in the process of allocating loads to those activities, so that alternative management practices can be implemented to reduce non-point sources.

EFFECTS OF DAMS

I want to shift now to the second water-quality threat. The natural flow and temperature dynamics were vastly changed by construction and operation of the big hydropower dam on the South Fork of the Flathead River upstream from Flathead Lake. In the summer, cold water from the bottom of the reservoir caused a 17 degree celsius temperature change almost instantaneously in the tailwaters as the generators turned on. Our studies showed that this was harmful to fish and invertebrates in the river (Stanford 1990) and even may have changed the heat budget of Flathead Lake downstream. These studies lead to recent retrofit of the dam for temperature management. Temperatures now are close to natural in the dam tailwaters and downstream. So again, management action has been taken as a consequence of the scientific information about the ecosystem-level ramifications of the problem.

Another problem related to dam operations concerns shoreline erosion. The flux of water through Flathead Lake was changed in 1938 by construction of a hydropower dam (Kerr) at the outlet. Spring floodwaters are held in the lake during the summer and fall to facilitate power production. Prior to the dam, the lake shoreline flooded briefly and then declined to minimum pool elevation. Since 1938, owing to storage for hydropower operations, the lake has been held at full pool allowing wave action to erode the top of the shoreline (backshore). The Flathead River delta has changed from a depositional to erosional zone and extensive shoreline reconfiguration has occurred (Lorang et al. 1993a). Moreover, suspension of eroded sediments in the lake reduces water clarity and is a nutrient source for algal growth. Through studying how these waves impact the shoreline and how sediment is moved around (Lorang and Stanford 1993), we've determined that by simply lowering the elevation of the lake one foot we could reduce the power of the waves striking the shoreline at full pull by about 60 percent (Lorang et al. 1993b). Fisheries and riparian problems caused by many years of extreme flow fluctuations in the river downstream from the dam also were documented (Stanford and Hauer 1992).

In relicensing proceedings for Kerr Dam, the Federal Energy Regulatory Commission (FERC) used our studies as rationale for changing dam operations to ameliorate erosion on the Flathead Lake shoreline as well as reduce the impacts of hydropower fluctuations in the river downstream from the dam. Again, a reregulation plan would not have eventuated without public interactions, because early on the dam operators, State, and Tribal authorities, had privately agreed to a mitigation package that largely ignored the science. Citizens objected and FERC produced an alternative plan that included detailed consideration of the management implications of the many years of research, including lowering the full-pool elevation of the lake to ameliorate shoreline erosion. The FERC plan also was subject to extensive public debate and many shoreline residents objected to the lowering of the full-pool elevation for fear of dewatering docks. Final decisions have not been made, but I can say at this time that the science and public concerns were thoroughly aired and appear to be decisively influencing the process.

FLOODPLAIN ECOLOGY AND INSTREAM FLOWS

Now I want to briefly show you how rivers are ecologically connected to flood plains, creating mosaics of riparian habitats, which influence water quality. A lot has been said in the preceding talks at this conference about ecosystem approaches to protection of small-stream riparian zones. These zones are substantially larger and more important in large gravel-bed rivers like the Flathead.

In the unregulated tributaries of the Flathead River, we recently demonstrated the importance of interstitial flow of river water through the gravel and cobble substratum of the expansive flood plains. Water penetrates the porous substratum at the upstream ends of the flood plains and flows through the lattice-like structure of the substrata. Interstitial flow of river water creates an underground aquatic environment that contains a complex food web, including many species of insects and crustaceans that are new to science (Stanford and Ward 1988). Microbial metabolism in these underground food webs elevates nitrogen and phosphorus concentrations as river-water fluxes through the groundwater flow pathways (Stanford et al. 1994b). At the downstream end of the flood plain, nutrient-rich ground water is forced back to the surface by natural bedrock constrictions of the underground flow pathways creating complex mosaics of riparian wetlands. Hence, the flood plains of gravel-bed rivers often are hydrologically and ecologically interconnected with the river channel by hypogean flow pathways. In the Flathead River and other gravel-bed rivers, these flood plains often exist from valley wall to valley wall and are arrayed like beads on a string from headwaters to piedmont and coastal valley bottoms (Stanford and Ward 1993).

We used this interstitial-flow concept with the Department of Justice and National Park Service to help resolve Federal reserve water rights for Glacier National Park, which is bounded by the North and Middle Forks of the Flathead River. In contrast to the usual instream flow argument to protect Park resources, we showed that river water and river food webs extend laterally far beyond what would normally be considered a 100-year flood plain and that protection of Park resources was dependent on reservation of the virgin flow of the river as the Federal reserve water right. Based on our studies the National Park Service argued that future developments of surface or interstitial waters of the river would be harmful to Park resources, such as bull trout that spawn and rear in the riparian wetlands. A spin-off is the protection of clean-water flows into Flathead Lake. The Montana legislature agreed with the rationale, and the Governor and the Secretary of Interior recently signed an unprecedented Federal water-rights compact that reserves the virgin flow of the rivers for posterity.

CHANGES IN THE FOOD WEB OF FLATHEAD LAKE

Clearly the lake is connected to its upstream catchment. During spring runoff, sediments naturally eroded from floodplain terraces in the unregulated portions of the basin are carried into the lake and provide a natural nutrient pulse. The lake is so big that the Coreolis effect of the earth's rotation circulates the spring sediment plume down the west shore and drives it back well up along the east shore. The ecosystem is "open," continually subject to natural and human-mediated external influences.

I now want to present a quick tour of the food web of Flathead Lake and show you a legacy of management failure resulting from ignorance of ecosystem function. The tour starts at less than ten microns in size with bacteria that interact with a photosynthetic alga in upper layers of the lake water. This is what scientists call a microbial loop because the bacteria are using exudates from the algae as nutrients, and cycling them very rapidly. The algae-bacteria complexes are food for a cladoceran zooplankton. The cladocera (water fleas) are fed on by all sorts of fishes, one of which is the westslope cutthroat trout (*Onchorynchus clarkii clarkii*). Historically, this fish was the preferred food of the top carnivore in the lake, the bull trout.

The cutthroat trout were largely replaced many years ago by introduction of Kokanee salmon, which were more efficient foragers for water fleas. Kokanee salmon became very abundant and a very popular fishery. In the fall, adult salmon migrated in large numbers to various places in the basin to spawn. The spawning salmon attracted large numbers of bald eagles which fed on them (Spencer et al. 1991). The eagles attracted large numbers of tourists and a micro-economy developed around this ecological phenomenon.

However, the eagle attraction did not last long because *Mysis relicta*, a large crustacean zooplankter, was introduced into Flathead Lake by fisheries managers in an attempt to enhance the Kokanee so that people could catch even more and bigger salmon. This was a big mistake because the end result was opposite to what was hoped for. *Mysis* feed at night on the small water fleas (cladocera) that were the food source for the Kokanee. Unfortunately for the Kokanee, *Mysis* live on the bottom of the lake in the daytime. They are nighttime ramblers. Kokanee feed only in the daytime when they can see the water fleas. Well, to make a long, sad story short, the *Mysis* ate all of the water fleas and didn't provide expected food for the Kokanee. In Flathead Lake there are now very few cladocera zooplankton and in 1988 the salmon fishery collapsed and has not recovered in spite of extensive restocking efforts. The eagles and tourists have gone elsewhere (Spencer et al. 1991).

Mysis also have now declined because other fish in the lake have increased population size by feeding on the abundant shrimp. The one that is the most successful is the one that evolved with the shrimp in the big lakes of the Canadian Shield area, namely the lake trout (*Salvelinus namycusch*), a non-native species that was introduced many years ago along with the Kokanee. We now have wall-to-wall lake trout in Flathead Lake. Probably in direct relation to the increase in highly predatory lake trout, the bull trout population appears to be declining rapidly. Lake trout are in-lake spawners whereas bull trout spawn in the tributaries. The new *Mysis* food source has allowed small lake trout to explode in numbers. As the fish have increased, they have depleted their food supply, forcing them to out-migrate. They are going everywhere. They're going downstream. They're going upstream. They're invading lakes in Glacier National Park and the consequence is they're probably preying heavily on the young bull trout in the tributary brood areas as well as in the Flathead Lake.

In this case too little information was available to justify introduction of *Mysis* and the consequences were too severe to allow an adaptive change in course when new information was available. Water quality in Flathead Lake, at least in terms of the native food web, was changed forever. It is important to note that this change was already well underway as a consequence of fish introductions early in the century.

CONCLUSIONS

Now to sum up. I've shown you the major ecological processes and responses in this regional ecosystem. The river and lake clearly are functionally interconnected in ecosystem terms. We have identified both natural and human-caused sources of environmental variation and the ecosystem is constantly changing.

I argue that we have been practicing ecosystem management from the very beginning in the Flathead. At the outset in the early 1970's, we defined our ecosystem as the entire catchment and we determined very early on the strong interactors that were most important to ecosystem structure and function. We made attributes of water quality that were important to people the primary indicator of ecosystem change. We defined ecosystem goods and services that were at risk and in several clear cases ameliorated the effects of human-mediated environmental change by adaptive implementation of management actions. And, we continually focused on them in terms of what was important for law, theory, and a public-management hierarchy. We monitored the system response and documented successes and, in the

case of *Mysis* introductions, also demonstrated management failure. We continually attempted to reduce scientific uncertainty through basic research and recognized that new information allows re-evaluation of the ecosystem processes and responses. When science and management actions are placed in proper human context through public education and debate, adaptive changes in management actions can effectively occur.

I recommend this experience as a potential model for ecosystem management elsewhere. The model is more formally presented in (Stanford and Ward 1992). Good luck.

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The Greater Yellowstone Ecosystem

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Abstract

Jurisdictional boundaries are artificial limits imposed on natural areas. The Greater Yellowstone Coalition (GYC), comprised of 100 conservation groups and 5,000 members, has assumed the role of addressing the many, complex problems created by these limits. Of particular concern has been private land development and agency inertia in protecting one of the last, more or less intact ecosystems in the temperate zone of the earth. The Greater Yellowstone Ecosystem includes Yellowstone and Grand Teton National Parks, seven national forests, three federal wildlife refuges, BLM lands, and private lands that occupy 10-15 percent of the 20-million-acre area. Our definition of ecosystem management is that which maintains the integrity, energy flow, trophic structure, biodiversity of species, and material flows of ecosystems.

The poor public understanding of the ecosystem concept, plus misinformation floated mostly by industry, were largely responsible for failure of the Greater Yellowstone Vision. The agencies, which have limited incentive to work together, did little to enlighten the public. Data quality and exchange have been a problem.

Our accomplishments include the Greater Yellowstone Tomorrow Project, a community effort to develop statements and understanding of shared goals among the communities. The Greater Yellowstone Profile document explains how the ecosystem functions. A 250-page blueprint is a GIS compilation of standards and guidelines. We pursue legislation including reauthorization of the Endangered Species Act, wilderness legislation, reform of the 1872 Mining Law, and consolidation of the Gallatin Forest in federal ownership. We facilitated negotiation between the state and federal governments to resolve water rights and prevent drilling that would alter Yellowstone's geothermal features. We successfully litigated the Targhee National Forest to stop overcutting.

I conclude that there are four challenges. (1) The agencies must assume leadership in ecosystem management. (2) The agencies must assume leadership in educating the public, pointing out the errors in misinformation. (3) The agencies must unify the commitment to EM within their own organizations. (4) There is a need for a new legal framework, including a monitoring mandate.

INTRODUCTION

I appreciate the invitation to be here today. I appreciate Susan's earlier invitation to be the rubber part of this conferenceit's true that I spend a lot of my time on the roadso it's a fitting metaphor. I don't have any slides so I am going to ask you for starters to close your eyes and picture Yellowstone in your mind. The geysers of Yellowstone. The elk herd migrating outside of the Park in fall to the north on the Yellowstone River. The antelope. The bison, now about 2,500 in number, centering around Yellowstone Park but migrating outside of the boundaries.

None of these animals understand or particularly care about the boundaries of the ecosystem which totals about 20 million acres in size, a slightly different figure from what some of the agencies are using these days. The problems of determining ecosystem boundaries, whether it's the wildlife migrating outside of the park boundaries or the geothermal resources which have hot-water aquifers extending far outside the boundaries, have created an enormous complex of issues and problems which we, as Susan indicated, started about ten years ago to address. I'd like to spend a few minutes talking a bit about our evolution—tell a few stories about what we've tried and what's failed, and what's worked—tying into some of the themes we've discussed this morning. And I wouldn't be doing my job if I didn't also include a critique of what some of the agencies have been doing and trying in the Greater Yellowstone. I will sum up with four challenges to the resource managers or the would-be resource managers in this room.

THE GREATER YELLOWSTONE COALITION

By way of introducing ourselves, I can't begin this discussion without recognizing one of our parents and mentors of the Greater Yellowstone Coalition, Rick Reese, who happens to be in the room with us today and without whom we probably never would have gotten off the ground. We are now a coalition of about 100 conservation groups which include regional, local, and national groups. We also have 5,000 individual members, about half of whom live within the three-state region of Wyoming, Idaho, and Montana.

[1]Editoral note: This paper is a transcription, slightly edited, from the recording of Louisa Wilcox's presentation.

We were created in response to growing threats perceived in the early 1980s, but they had been going on for quite a while. The growing threats ringing the Greater Yellowstone region include oil and gas leasing, development pressures to the east, a lot of clear-cutting concentrated on certain national forests: the Targhee, which I will talk about a little later, the Gallatin, the Bridger-Teton, and portions of the Shoshone.

There are hard-rock mining threats to the north, particularly in Montana with the new platinum mine, and a new gold mine being developed within three miles of Yellowstone Park. There are geothermal threats. Some are to the west of Yellowstone National Park in Island Park, Idaho, where there is a considerable amount of commercial interest in developing that area. There are more recent threats near Gardiner, Montana, north of the Park's boundary, where there's been an interest in geothermal development on the part of a religious cult, the Church Universal and Triumphant from California.

We have threats of all kinds—water-development threats, different kinds of dams and diversion projects—on the way. There is almost no problem that we don't have, some arising in a serious way since the Coalition began.

The one of particular concern is the one that Jack just mentioned in his talk: private land development and subdivision. There is an enormous amount of pressure in the 20 counties surrounding Yellowstone to develop the private lands which are often critically important in the ecosystem. The river-bottom country and the winter range are small in acreage, but are vitally important to the ecosystem. If we lost them to development, a lot of the ecosystem function and even some of the species would not be able to survive. So we developed in response to all these threats.

We also developed in response to what we perceived as agency inertia. The agencies were not taking the lead, were not picking up the ball and doing something about protecting one of the last remaining ecosystems in the temperate zones of the earth and in the United States that could be considered more or less intact. It is one of the larger areas that functions more or less naturally. The agencies in the early 1980s were not doing much to address some of the critically pressing issues.

Of course the jurisdictional problems are very difficult, as discussed by Professor Coggins and others throughout the day. There are two national parks at the core, Yellowstone and Grand Teton, surrounded by seven national forests answering to three different Forest Service regions. There are three wildlife refuges answering to the Fish and Wildlife Service. There is BLM land scattered around the lower-elevation areas in the three states, on and on and on. There is a very complicated land pattern in the area that makes collaboration, joint problem solving, and intelligent management very difficult.

We are a conservation community, however, and we are concerned. Many of us live in the communities. Many of our board members live in the communities. Many of our member groups and members live in the communities. We are concerned about the future of these communities and their sustainability. I will be getting deeper into some of these related issues and I will talk more about them later.

THE GREATER YELLOWSTONE ECOSYSTEM

The idea of an ecosystem, and Greater Yellowstone as an ecosystem, has been around for a long time. Frank and John Craighead coined the term Greater Yellowstone Ecosystem to describe bear habitat areas which the grizzly bears were using. Much of this lay far outside the boundaries of Yellowstone Park as early as the 1960s. Since then the term, and our understanding and use of it, has expanded to include watersheds, to include many other species, and to include ecological processes. When you mention that word in Yellowstone, you may recall the fires of 1988 in terms of large-scale, natural processes that are important to the functioning of Greater Yellowstone.

Everyone else has offered a definition of ecosystem management, so I will weigh in too. I like Professor Coggin's term and I'm a little concerned that it may indeed resolve into what managers do. We may call it ecosystem management but it may be something quite different from what we in the Coalition mean by it. Our term includes that which maintains the integrity of ecosystems, their energy flow, their trophic structure, biodiversity of species, and their material cycles.

Ecosystem management is not, in our view, what Montana Senator Conrad Burns referred to a few weeks ago. Senator Burns was using ecosystem management and the need for ecosystem management as an excuse not to designate any more wilderness acreage in Montana, and as an excuse to put every acre into commodity production. If for some reason, like the presence of an endangered species, you can't do commodity production on a certain number of the acres, then you should certainly try to make it up elsewhere.

That is not what we mean by ecosystem management. But we need to be aware that this term is being used for all kinds of ends which I don't think the biological, the academic community, Jack Ward Thomas, or other people mean. It is being misused and I think that's an issue which the managers are going to have to address if the term is to have meaning in the long term.

We've run into many problems that were itemized very clearly this morning. There are many disincentives to managing this area of Greater Yellowstone as a functioning area. The first begins with defining it and defining the boundaries. We were asked early on, from folks in Logan actually, to include the Greater Yellowstone down to at least Logan Canyon. So there was a lot of discussion about where the boundaries of the Greater Yellowstone should be. We did not do that, by the way. We're still only in three states although people accuse us of wanting to extend all the way to Tierra del Fuego. In fact, with certain migratory birds, where do you stop? It's a hard question.

But for the sake of convenience, as I said, we use a 20-million-acre area. About 10 to 15 percent of that is private land in the lower-elevation areas that are critically important to sustaining Yellowstone as an ecosystem. Defining the perimeters is a very difficult problem and we've relied heavily on science. We have a Science Advisory Council which includes a number of academics, one of whom, Barrie Gilbert, is down here. A number of academics in the community around Yellowstone help us sort through various problems.

We made a decision of convenience, recognizing that we didn't need every acre with all the migratory bird species. It is a large area of natural ground, more or less centered around the two parks, which contributes what is necessary to maintain natural processes such as fire, minimum viable populations of native flora and fauna, and well-distributed native habitats, the vegetational components. So we tried to be somewhat systematic in how we defined it, and recognize that it's not perfect. It will always be open to debate, further discussion, and refinement. And that's fine. It's just that we had to have a piece of ground on which to work.

LOTS OF PROBLEMS

The public understanding of ecosystem is still relatively low, and I still get phone calls from places like Afton, Wyoming, periodically. "I don't like this idea of Greater Yellowstone Ecosystem." I said, "Well, you know it sort of exists. It's out there. It's a concept. It's not a matter that we invented it to shut out all sorts of commodity production, something we are constantly accused of doing." And so there is not a very good public understanding. Ecosystem is still a mysterious term. It seems suspicious to people who are not fully aware of its meaning.

And I think this was really the reason that the first attempt at working on a joint vision, primarily between the Forest Service and the Park Service, called the Greater Yellowstone Vision, failed. The public didn't understand what it was and really didn't much want it. We were supporting it. It was certainly a step forward to define a philosophy, a way of looking at Greater Yellowstone, and estimating its values and working to sustain them. It was a first step in what could have been a policy developed toward protecting and conserving Greater Yellowstone, and the communities surrounding it, as an ecosystem.

But not only was there a great deal of misinformation floating around, mostly from industry, but there was so little work done to educate the public about what it really was, why it was important, and what it wasn't. There developed such a level of controversy that the White House asked the Forest Service and the Park Service to back off, and you all know the story of the regional Park Service director and a regional forester losing their jobs over this.

It was highly controversial. But the real issue was, a huge amount of misinformation about Greater Yellowstone being a lock-up of resources, and the agencies which had the most at stake and the most to lose were not out there in the communities saying, "This is what it is. It's really not that scary. We're not expanding the boundaries of Yellowstone to include Laramie, Wyoming. We are basically trying to provide a broader vision within the existing land-management frameworks that we all have, and the goals and the legislation that we all have. The purpose is to provide for more intelligent management so your grandkids have geysers to look at, and elk to hunt, and fish in the rivers, and the like."

It was a very simple and benign effort. And critical to its success is public education. Bret made this point earlier. And the agencies have to take the lead in explaining it and in selling it. They have to take a lead in having a public dialogue on it or it won't happen, and it won't happen because the public won't understand it. They won't accept it. Just like they didn't understand and didn't accept the Greater Yellowstone Vision document about four years ago.

Another problem that we face is that there are no public incentives. For a good business owner in Ennis, Montana, who is trying to do the right thing and act in an environmentally benign way, there really aren't any good economic incentives. This is true both for the business people and other community members who want to behave responsibly. And there ought to be some things that we can do about that.

The transboundary legal issues are serious. Professor Coggins referred to them earlier but we visit them every day. And I will give you an example. Yellowstone was established in 1872 primarily to protect the geysers. The monument of Yellowstone Park was really the geysers and no one understood then the extent to which the hot-water aquifer extended far outside the boundaries to the north and to the west, and there was no legal framework. There was no legal structure to prevent underground hot-water pumping outside the boundaries of the park even if that meant screwing up the plumbing system of the geysers inside the park. The transboundary issue and the legal system simply didn't address that problem.

There are also very few administrative incentives to do ecosystem management. That hopefully is changing with the new chief of the Forest Service, Jack Ward Thomas. But after sitting in the room as I have over the last eight and half years in meetings of the Greater Yellowstone Coordinating Committee with the agencies, primarily Forest Service and Park Service, it is clear to me that there is very limited incentive for them to work together. There is still a tremendous amount of competition, jealousy, friction, and all the rest occurring despite the veneer of cooperation. That creates real problems in terms of getting together and working on some of these very severe problems. The administrative incentives in Greater Yellowstone were very much dampened after the demise of the Vision document. To quote Yellowstone Park superintendent, Bob Barbie, "Louisa, adventurism is not rewarded."

So the idea that the Park Service would step outside the boundary of Yellowstone Park to work on the issue of its bison migrating outside and down the Yellowstone River Valley where the state of Montana was in a complete uproar because it didn't want them and were trying to shoot them, was not on their agenda. The idea that the agency would go outside its boundaries and willingly negotiate and deal with the ranching community, the state of Montana, and private land owners was foreign to them even though these were Park animals. It was an enormous issue that needed to be addressed. So adventurism is not rewarded and I think that largely still stands even though we are hearing some different signals from the top levels.

Data quality and exchange have also been a real problem. This has been especially true of transboundary data. If you look at any of the maps that were assembled at the time the Greater Yellowstone Vision document came out, you will see large data holes—inside Yellowstone Park, or on particular forests, or on elk migration routes stopping at forest bor-

ders—because nobody kept up with what was going on with the other side. There are enormous holes in the database even on the hook-and-bullet species on which there's been a tremendous amount of money spent, let alone the sensitive species that hardly anybody seems to care about. There are tremendous problems with the data and the way the data are collected that really work against the notion of ecosystem management. It has already been mentioned this morning by Dave Roberts and others that the time frame in which the data are collected is frequently so short that it doesn't really allow you to see what the long-term trends are, what the bigger-picture patterns are, and what long-term human management is doing. There are some very difficult issues because of the way the data are or are not there.

The politics have not been particularly friendly. I'm about the only speaker so far who can talk about the politics. They aren't particularly friendly in terms of understanding and appreciating the importance of protecting these resources on a large ecosystem, or regional, or landscape scale. The politics are very resistant to change. I need not mention names, but we've had some very unfriendly personalities in the Senate from Wyoming. For example, they haven't been particularly interested in seeing Yellowstone restored to its former whole by reintroducing wolves.

The budgets haven't been in sync with the needs of ecosystem management either. They've been spotty and short, particularly in recent years. As a result, we've lost key people. The ones who tended to flee and leave the agencies were some of the natural-resources people who are most needed in terms of their understanding of ecology, hydrology, and geology, and how these resources work. Losing them has been a critical loss in Greater Yellowstone.

The pressures are so great and the problems are so big that a lot of people ask me why I haven't moved to Alaska where there's hope. My response is if we can't protect Yellowstone—the nation's first national park and some of the first national forests, the home of the grizzly bear which is down to 1 percent of its former range, the home of the black-footed ferret, bald eagle, peregrine falcon—if we can't manage and protect an area that's an ecosystem in Yellowstone, where can we and what hope is there for other countries? I see this every summer because there's always a flood of people from Indonesia, Poland, or other places who come into Yellowstone to look at the great example of American conservation, and I really feel it. If we can't really be the model of ecosystem protection and conservation—not just as we were in 1872 when Yellowstone Park was created or when the Forest Service was first created—how can there be any hope for some of these third world countries, which are a lot poorer, to protect their rain forests or what's left of their environments. So that's what keeps me going, I guess.

ACCOMPLISHMENTS TO DATE

What we've done is a series of things. Some of them have not worked, and others have worked rather well. I had never heard the term "collaborative learning" before, but that was the term Professor Daniels used this morning and I liked the sound of it.

One of our first steps was really to try to define a joint vision of the communities of Greater Yellowstone. We launched a project called the Greater Yellowstone Tomorrow Project which is just wrapping up now. It has lasted for quite a while in various forms. It was a community effort designed to develop, where we could, some statements and some understanding of shared goals in some of the communities. We found pretty much what you'd expect. The people are really there because of the clean water, the hunting and fishing, and other recreational opportunities. We also found, much to our surprise when we started digging into some of the economic data in the communities, that there is amazing growth in the economy of the Greater Yellowstone region and a number of people are moving there. In fact, we totalled up the growth in the 20 counties around Greater Yellowstone, and calculated that if it were a state it would be the fastest growing state in the country.

So the people who are moving there are not moving for extractive-industry reasons, as has been the case over much of the history of this region. They're moving there for the quality of life and the quality of the environment. We would like to call them "the motive cowboys." But there are also a lot of footloose businesses moving into the region which are not dependent on being in a city or an urban environment. So our economy is healthy and it's very clearly dependent on the health of Greater Yellowstone. That's why it is growing and that's an important issue and people are beginning to realize it. We just analyzed census data and state economic data, but it was really a social learning process with these communities.

We have also pulled together a publication called the Greater Yellowstone Profile, which is sort of a scientific document on how Yellowstone works as an ecosystem. The agencies should have done this. We were somewhat limited in terms of our credibility because we are a conservation group. But I think it was a pretty credible document. It really did a lot to help people understand how bison are part of this larger picture that we call an ecosystem, and how watersheds work in the larger whole.

We are also just releasing a 250-page blueprint of Greater Yellowstone. It's a compilation of standards and guidelines with all sorts of maps. It is based on a GIS analysis of national parks, fishery and wildlife resources, geothermal, private lands, etc. We pulled together the best information we could find. It includes what the forests are doing which is something that the Forest Service should have done a long time ago. For example, what are the riparian standards that make the most sense, and where are they working? What are the best wilderness management plans, who's using them and what are the results? There are some very interesting site-specific successes that the agencies involved are giving very little visibility. So we pulled together this document and it's going to be on the streets soon. It just got back from the printer.

We've been following a lot of the decision-making processes that may be where you have heard about us, you know filing appeals, etc. We try to do our homework on these appeals and we've had a fair amount of success. I know that litigation has a bad name. But I would argue that it has a positive role in holding the agencies accountable for uphold-

ing the law. This is something that Jack Ward Thomas has also said is important.

We pursue legislation. The Clarks Fork Wild and Scenic River was the product of a campaign that we ran for number of years with a number of other groups. We've been working on wilderness legislation and on reauthorization of the Endangered Species Act. We are also working to reform one of the laws that is perhaps the worst enemy of ecosystem management, and that is the 1872 Mining Law. The agencies have no authority to say no, no matter how bad a mine is. There's one mine right on the border of Yellowstone Park which we are trying to stop, and one of the reasons that it has a likelihood of going forward is because the 1872 Mining Law is still extant. It might have been relevant in 1872, but it's certainly not relevant now. It's a real problem for the agencies trying to manage on this broader landscape level.

We have had a number of conservation biologists, landscape ecologists, and other scientists look at our blueprint document. There are a number of these kinds of people on our science council. We took a hard look and asked what Yellowstone would look like if we provided for viability of native flora and fauna, endangered species, sensitive species that might get that way, and if we provided for a well-distributed series of plant communities throughout the landscape. We took into account that human activities have been changing the landscape. We specified that this system would have to be large enough, with the right distribution of habitats, watersheds, etc., to encompass large natural disturbances like the Yellowstone fires and beetle kills. We asked this question of everybody, including the science types, of what Yellowstone would look like on a large landscape level if we provided for all these elements.

And the answer was: a lot more wilderness. In fact the former president of the Society for Conservation Biology, Peter Brussard, who used to be at Montana State University, said incorporate every acre of roadless country you can get because we have so many encroachments on the outside and all of the recreational-use problems in Yellowstone Park. That amounts to 3.6 million acres of additional wilderness on BLM and forest land, and about 2.1 million acres on national park land in Yellowstone and Grand Teton.

Our advisors also recommend that we need to stop thinking of Yellowstone as an ecosystem in isolation, but really look hard at the ways of connecting Yellowstone into other adjacent ecosystems. In this case, our closest neighbor is the Central Idaho Wilderness Complex. So, with help from agency people and others, we started looking hard and mapping some possible linkages. That adds up to—and it doesn't have to be all wilderness designation but will include linkages for wolves and other animals—about 1.39 million acres. I know these sound like scary numbers but when you look at how isolated and how fragmented Yellowstone already is and you ask the question, these are the answers you get. In addition, consideration needs to be given to a lot more miles of protected river, whether it's through cooperative protection systems locally, or whether it's through what was done recently on the Henry's Fork, a state-protected river.

You wind up having to restore huge amounts of acreage that have been clear cut and roaded such as on the Targhee National Forest. You wind up having to make wildlife refuges into functional refuges instead of little postage stamps in the middle of a sea of other things happening around it. You wind up—and this was really a critical thing that we concluded because we don't know enough about managing these resources—understanding that it is high time for an independent scientific review capability to advise the agencies on an ongoing basis as to what needs to happen in the way of new studies and the implications of those studies. An ongoing independent scientific voice is critical to face the challenges ahead, and to close the science-policy gap between science generated by universities and science produced by managing agencies. We really need an outside voice to come in and take a hard look.

SOME CASE STUDIES

I would like to focus now on a couple of case studies that are examples of different tools being used, some of which were referred to this morning. The first tool is legislation, pretty straight forward. You can go to Congress and ask for a position on something. In this case I will talk a little about the change in land jurisdiction.

Somebody talked this morning about the problem of checker-board railroad sections. We had the largest roadless area in the northern part of Greater Yellowstone in the Gallatin Forest, riddled with checker boards from the old railroad days. A huge problem. The Forest Service couldn't manage it, and it went from Plum Creek's hands, which was a subsidiary of Pacific Northern to a real bad type of developer out of Oregon. So we were very nervous about what the prospects were for the Gallatin staying roadless, and we and the Forest Service worked very hard.

Actually, I don't think the Forest Service could have done this alone because the politics involved were very shifty. This developer was very resourceful, and every time we thought we had the problem solved he would pursue a different strategy.

But we finally got a bill passed through Congress that consolidates the Gallatin Range in federal ownership. That will make life a lot easier, not just for the Forest Service, but it will make it possible to manage this area as a contiguous roadless block which it pretty much is now. So it's a huge step forward. Yes, it was a congressional fix, but it addressed an underlying problem. It was a real disincentive to managing this area as an ecosystem as long as those private-end holdings were there.

And it was no small matter. It was 80,000 acres, and we had to do a land exchange and a purchase. It got very complicated and it took our staff almost full time for nearly a year to get it done. But it was a critical turning point.

Another case study refers back to the same tool that Jack Stanford used in the Glacier Park Compact situation. This was a negotiation process between the state and federal government to resolve water rights, in this case Yellowstone's 1872 water right. We used an existing tool that wasn't designed for dealing with Yellowstone's geothermal resources and adapted it to deal with the threat of development

to the north. The development includes not only the Church Universal and Triumphant, who were trying to pump and develop the whole greenhouse spa thing just outside the Park, but also pumping that was occurring in the area as a result of this huge explosion of private land development.

The proposed pumping posed a certain degree of threat, according to the experts. If you pump enough cold or warm water out of the same area, you could be upsetting the plumbing system inside the Park by changing the hydrologic balance of the area. This hot-water system goes for miles outside the Park because people hit it once in a while drilling for domestic wells. It has been ratified by the state legislature and signed by Secretary Babbit. So it's a huge problem, a huge level of uncertainty. It raises the question of what do you do in the face of not knowing much about how the geyser system really works.

So we used this negotiation process to bring everybody to the table. Even the Church Universal went along with it. We still have to get a congressional fix on their problem, but we used it to bring everybody to the table.

What we got was a scientifically drawn zone of geothermal concern. It took a while because we had to bring in academics, the state agencies, the feds, and everybody else. We have also used it to include a scientific voice on any well proposals that come up, domestic, hot, cold, or otherwise. The state does not necessarily have to listen to it. That was something that we couldn't get the legislature to buy. But the scientific community nonetheless has a voice in the permitting process for domestic wells. And that's going to be critical because if you start seeing temperature or chemical changes, you could be doing something at least to the Mammoth Terraces if not further into the Park.

So an ongoing scientific voice and adjudication of Yellowstone Park's water rights have satisfied Park officials that its interests have been cared for and its water rights protected. We supported that, and everybody supported it. Everybody felt good about that, and we used an existing tool that wasn't meant for this purpose but adapted it to deal with one of the problems.

The third case study I will mention is litigation. Litigation can be an important tool, and I will talk about it in relation to the Targhee National Forest. In this case, the Forest Service wisely used a lawsuit that we filed on endangered species to turn an important corner on this forest. It should have been done a long time ago.

Let me paint a little picture for you. This was a forest where a decision had been made about 20 years ago to harvest unsustainably, to depart from sustainability because a lot of acres on this forest had been killed by beetles. It was true. There had been a huge beetle epidemic.

The situation got out of hand because the Forest Service couldn't stop it. The politics sort of took over. They had been into the program for about 10-15 years, and it was clearly time to stop. But the pressures from the mills, the senators from Idaho, the Forest Service, and just about everybody else were such that the Forest Service couldn't stop. They couldn't tell Senator McClure, "No we're not going to do this anymore." Senator McClure wouldn't take that for an answer, and then Senator Craig also wouldn't take it for an answer.

So they kept overcutting, and they started cutting all of the leave strips, and they created on Yellowstone Park's west side eight miles of clearcut right up to the Park boundary. That's the one you can see from the moon. It's a real embarrassment to the agency. And what went along with that clear cutting was a road-building program that didn't have any standards or sideboards because its forest plan was an old plan. It didn't use the science that is available to forests now on the importance of regulating roads and road density. So it became the only forest in occupied grizzly bear habitat in the lower 48 states, with no, count them, zero, road standards. And they had upwards of six miles of road per square mile. It was a mess and they lost their grizzly bears. It was part of the occupied grizzly bear zone and since about 1983 or 1984 there have been no females with cubs sighted on the two bear-management units in that part of the Targhee. And they were the units that had bears. For the other units, there was a clear correlation between the road building and clear-cutting program and the fact that they did not have bears anymore. And despite all this, the Forest Service did not change course.

The conservation community first initiated a series of discussions with the past forest supervisor. I've become personal friends with some of the local loggers who also realized that the program was unsustainable, and the longer the agency kept overcutting with big clear cuts, the less prospect these people had of any kind of future. They could see the writing on the wall. As the leave strips went down, they knew that they didn't have much prospect unless something stopped. One old time logger, who must have been 80 years old, told me, "You got to get those guys because you know our future is tied to that too."

So we went to the Forest Service and we tried to negotiate this situation, a series of closures and moratoria on the most intensively cut area. We had at one point agreement between the Fish and Wildlife Service, Idaho Fish and Game, the conservation community, and the small, independent loggers who numbered about 250. But the bigger user groups had a few people in the room representing their interests on what should be done. And somehow the psychology changed. All those agencies, the conservation community, and the Forest Service eventually said no.

I was shocked. As we left that room I commented, "You know, we're going to have to litigate this." There was a clear violation of the Endangered Species Act. They were the only forests without any road standards. All of the other forests in grizzly bear area have road standards.

We filed a lawsuit last summer. What came out was some critical information. Despite a Forest Service commitment to leave 50 percent cover in this one area west of Yellowstone Park, they were down to 20 percent. They couldn't log in that area anymore for about 11 years until they got enough regeneration and growth to provide cover for other big game. They also made a huge change in the way the elk migrated out of the Park and got a blood bath on the way down to their winter range at the sand dunes in Idaho. So they basically were way over the cover constraints they should have left.

We suspected that they never would have taken a step back. We talked about cumulative effects and the importance

of looking at cumulative effects in the basic data. And they replied "Where are we? Have we overcut?" And they had. They were finally forced to step back because of our lawsuit.

I have to credit a couple things. One is our lawsuit that made everybody look. I also credit the leadership of the new forest supervisor, Bill Lavere, who was only acting at the time. He took one look and said, "You know, it's not here." And we replied, "Yeah, that's what we've been telling you. It's not here and we shouldn't be cutting what's left." He was the one who settled the lawsuit with us by implementing road standards that make the most sense, biologically, and stopping the cutting. He has really gone the distance on this issue.

But it is a real tragedy. The Forest Service would have kept overcutting until somebody took them to task. And there were so many people on the inside of the Forest Service who knew it was wrong but couldn't change the basic dynamic of what was happening. So I would argue that litigation has a role in terms of accountability. Maybe we will not have to do this as much anymore since Jack Ward Thomas has made a big point about obeying the law.

We have also developed a group with the small loggers to try to find other things including road closures, stewardship contracts, and small thinning projects to help them. We are trying to be sensitive to the impact this is having on some of the small independents. We have had pretty good luck at least identifying some potential areas, fighting hard to break up some big sales, and trying to encourage reserve sales for small operations. Last summer we created a task force, the Targhee Timber Task Force. I and this one small logger are on it. The Forest Service didn't want me to play a role. I was sort of the wrong age, the wrong sex, the wrong religion, and I was from Montana not Idaho. So I had all strikes against me.

But they were desperate and we wanted to be helpful to them. We identified some areas that were non-environmental issues. One was how the contracts were structured. It was a problem for them and we've been working on trying to help resolve this through appropriations for service-group contracts. So we're trying to be part of that solution even though it is my forester friend who needs a break. This is a forest that cannot take a lot of cutting and a whole lot of roads have to be closed, not only for grizzly bears, but indeed as a measure of the ecological health of the area.

CONCLUSIONS: THE FOUR CHALLENGES

Ecosystem management isn't going to last unless the agencies here and elsewhere make it meaningful. There are a number of people, not only from the conservation community but elsewhere, who are concerned that it's just another euphemism, just another term for clear cutting. It will become a new prospectus before too long, and four things need to happen. The first challenge is for the agencies to take some major areas of land where there are real natural-resources issues. They have to take the leadership in trying to resolve these in the interests of protecting the resources and of protecting sustainability in the communities. The faith in ecosystem management as a solution will not last unless the agencies do something meaningful.

Secondly, the agencies also must explain to the public why this is important and why it must be done. If they don't, as I indicated before, it will fail because the public doesn't understand what this is all about. The public will not accept it unless there's some clear and pressing reason, like impinging upon their fisheries opportunities, or clean water. It will fail utterly unless the agencies do something that they haven't done particularly well in my history in Greater Yellowstone, which is communicate to a broader array of publics than they have communicated to in the past.

And when misinformation comes out, which it will, like Conrad Burn's crazy statement, the agencies should be on top of responding to that. The agencies need to correct the record and make it a term that the public can live with, otherwise it'll just become a term that will be reduced to basic nonsense. If the Conrad Burnses can use it as a way not to create another acre of wilderness, and as a way to emphasize commodity production, something is wrong. That's exactly what we need to get away from, and the agencies need to set the record straight. It may not put them in a popular position, but unless they do it their endeavors and objectives will be compromised.

As a third challenge, there's an uneven commitment between parts of the agencies, the Forest Service as an example, to ecosystem management. Somehow they need to resolve this. For every step forward the Targhee has taken, there have been people on the inside betraying the leadership in an effort to thwart the day that change had to come, that roads would be closed and clear cuts would be halted. They have to obey the law and tell the truth. I don't need to say any more, but litigation will be there if the agencies don't take seriously their mandate to obey laws like the Endangered Species Act, Clean Water Act, and the other laws that have something to do with protecting areas as ecosystems.

Fourth, I think we need a new legal framework. We had an interesting situation develop in Greater Yellowstone after a congressional oversight hearing in 1986 or fall of 1985. Congressman Seiberling and Congressman Vento were very interested in doing a federal legislative fix on Greater Yellowstone management. The agencies were driven to the Greater Yellowstone Vision document out of fear of Congress.

Professor Coggins really laid it out clearly. There isn't a legal framework to do all of what is needed in ecosystem management and there should be. So I think we need to get less afraid of legislation to provide a framework for making ecosystem protection a priority, for getting ahead of the endangered species situations by mandating protection of viable populations of native flora and fauna. The National Forest Management Act has a provision like that, but BLM doesn't have it nor does the Park Service and that's a problem. It would be useful to have a clearly mandated priority to protect ecosystem integrity. It would be useful to have a mandate that would close the policy-science gap by providing on-going outside peer review in an area that's very complex, that not a lot of people know much about, where there's a lot of uncertainty, and which changes continually. It would be useful to have an ongoing review and critique of what the scientists are saying should be done.

It would be useful to have a different kind of monitoring mandate. Monitoring is one thing the Forest Service and BLM do last, and so they don't learn from what they've done in the past. It would be useful to have a monitoring mandate because it would help with the budgeting process and get away from this annual budgeting-cycle problem. If there were a mandate for long-term monitoring, there would be hope for budgeting it. Under the current system we are stuck with the agency's annual budget process, and it is subject to the whim of whatever politics are going on at the moment.

It would be useful to have a mandate to provide incentives for planning and information transfer to local communities on private-land issues. It would be useful for promoting a community dialogue. We've proposed a commission on community sustainability just in Greater Yellowstone to provide information to local communities on how they can develop businesses that are economically sound, how they can change tax structure, and all the rest.

But if we don't have a broader legal framework I can promise you that we will have crisis after crisis which is what we have experienced in Greater Yellowstone. The crisis of the fires produced better forest lands. Why did we have to go through that grief? The crisis of bison is producing a dialogue in planning on bison. The crisis of our grizzly bear litigation is producing some movement forward. Why do we have to be crisis-driven either by some outside event like the Yellowstone fires, or inside events like sometimes occur. I think unless there is a broader legal framework making ecosystem management and ecosystem protection a priority, it will be crisis after crisis under the existing legal framework.

I appreciate the opportunity to be here today and I know I have probably exhausted you, but if there are any questions I would be happy to answer them.

SESSION 3. THINK-TANKING THE CHALLENGES IN THREE REGIONS

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BREAK-OUT SESSION 1: THE GREAT BASIN

G. Allen Rasmussen, Discussion Leader
Neil E. West, Recorder

BREAK-OUT SESSION 2: THE COLORADO PLATEAU

Barbara R. Rusmore, Discussion Leader
John C. Schmidt, Recorder

BREAK-OUT SESSION 3: THE NORTHERN ROCKIES

Rick Reese, Discussion Leader
Mark W. Brunson, Recorder

Break-out Session 1: The Great Basin

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Abstract

The most unique characteristics of the Great Basin are the ecological fragility of the resources, scarcity of water, predominance of federal land, high degree of urbanization, independence of rural people. Factors most likely to impede EM are conflicting goals and missions of agencies, conflicting social values among stakeholders, slow recovery rates of biophysical systems, and difficulty of predicting responses to natural disturbances and management actions. Characteristics most likely to facilitate EM are new political climates promoting consensus, extensive federal lands, social diversity, and improving management technology. A critical need for successful EM is communication and promoting public understanding of the process.

PARTICIPANTS AND PROCESS

The focus of this group's efforts was the Great Basin, the region bounded on the east by the Wasatch Mountains and Wasatch Plateau, and extending south along the Hurricane Fault. Its western boundary is the Sierra Nevada and Cascade Mountain ranges. Its northern limit is the Columbia River, and its southern is the Mohave Desert. The number of participants was approximately 80.

Participants were asked to focus on three central questions posed to each break-out session without spending time on exact definitions of region, ecosystem, or ecosystem management. The participants were divided into subgroups to prepare lists of (1) the unique biophysical and socio-economic characteristics of the Great Basin, (2) factors likely to constrain the practice of ecosystem management in the region, and (3) factors that offer opportunities to enhance implementation of ecosystem management in the region.

The three groups were then reconvened, and each was asked, in round-robin fashion, to state its most important items associated with each question. Once the three master lists had been prepared, all members were asked to vote on their personal first and second preferences under each of the three questions. The session chairs then ranked four to five features of the region collectively judged to be the most important for each question.

UNIQUE CHARACTERISTICS OF THE REGION

The group identified 21 characteristics that render the Great Basin unique in implementing ecosystem management (Table 1). About 60% of the attributes were biophysical features and about 40% were socio-economic-political in nature. The five judged most important by the group, however, were predominantly the social characteristics. These were:

1. ecologically fragile upland resources
2. scarce water, and very limited and sensitive riparian areas
3. predominance of federal lands
4. high degree of urbanization
5. highly independent people residing in rural portion

FACTORS LIKELY TO CONSTRAIN ECOSYSTEM MANAGEMENT

The group identified 25 potential constraints on ecosystem management in the region (Table 2). These divided about equally between biophysical and socio-economic-political issues, as did the short list of most serious constraints. The latter were:

1. numerous action and regulatory agencies at all levels with conflicting goals and missions
2. conflicting social values among stakeholders
3. slow recovery rates for the biophysical systems
4. non-linear, hard-to-predict responses to natural disturbances and management actions

FACTORS LIKELY TO FACILITATE ECOSYSTEM MANAGEMENT

The group developed a list of nine opportunities (Table 3) likely to facilitate ecosystem management in the Great Basin. Some of these were the positive side of some of the identified constraints. The leading four opportunities were:

1. new political climates allowing search for consensus
2. large blocks of federal land
3. diverse people, from original settlers on the land, to urban technocrats, to recent immigrants
4. technology for restoration and increasing biodiversity is available.

TABLE 1. CHARACTERISTICS OF THE GREAT BASIN REGION RELEVANT TO ECOSYSTEM MANAGEMENT.

Votes	Characteristics
23	fragile resources (slow recovery rates, limited site potential)
19	scarce water
14	federal land and multiple-use dominate
7	highly urbanized, unevenly distributed human population, rapid population growth
7	rich history, cultural dominance by independent people
7	large, relatively homogenous ecosystems, mostly still intact
5	no outlet of water to the sea, its quality declining with distance from headwaters
4	private lands locked in a "sea" of federal ownership
3	riparian areas few and sensitive (unlinked oases altered by irrigation)
3	agriculture mostly ranching
3	center of feral horse population
3	limited transportation and related infrastructure in center
2	mountains in a "sea" of temperate (cold) desert, limited forests
1	salt-affected soils dominate
1	exotic plant species on increase, vegetation evolved without grazing
1	great climatic variation with snow dominating in the precipitation pattern
1	great mineral wealth connected to boom-and-bust economics
1	inland seas (closed basins, terminal lakes) with many migratory birds
1	good air quality
1	many sensitive species

TABLE 2. CONSTRAINTS ON IMPLEMENTING ECOSYSTEM MANAGEMENT IN THE GREAT BASIN.

Votes	Constraints
18	variation in philosophical view of ecosystem management
14	numerous agencies at all levels pursuing conflicting goals and missions
13	changing social-political-economic structure (urban vs. rural groups) with conflicting values
5	slow ecological recovery rates, limited potential of land for productivity
5	economic viability versus sustainability
5	threatened and endangered species
5	lack of effective communication and coordination
4	non-linear, difficult-to-predict biological responses to natural and management influences
4	subsidized water and power
4	water scarcity, frequent drought
4	archeological and historical values
4	frequency of fires that alter ecology
4	existing water law and property rights
4	low rewards for field workers achieving results on the ground
4	political and ecological boundaries do not match
3	popular conception of area as a wasteland, placement of hazardous, toxic wastes
2	independent life styles of rural people
1	no universal standards for ecological condition
1	non-native species invasions
1	low incentives for private landholders
1	lack of political clout in national politics
1	vast size and low economic base limits development of transportation and communication infrastructure
1	antiquated mining laws
1	boom or bust economies connected to mining and military

TABLE 3. OPPORTUNITIES TO FOSTER ECOSYSTEM MANAGEMENT IN THE GREAT BASIN REGION.

Votes	Opportunities
38	new political climate for reaching common goals
16	people as a resource, well-educated, ready to move beyond gridlock
10	large blocks of federal land
9	technology available to restore degraded land and increase biodiversity
8	refuge and relicts as sources for restoring biodiversity
4	mini hydrologic basins that could be used as demonstration sites
4	educational and research institutions that are ready and willing to help
2	rich mineral resources
1	North American Waterfowl Management Plan
1	technology available to inventory and monitor resources (remote sensing, geographic information systems)
1	lots of solar, wind, and geothermal energy-development opportunities

SUMMARY

This session provided a very useful discussion of the types of constraints and opportunities the Great Basin Region presents to implementation of ecosystem management. It did bring some focus and realism to the statement by Dr. Thomas that "ecosystems are more complex than we can think." However, it only touched the surface of the issues because of the time constraint. Just as most of the presenters in this conference discussed how the complexity of an ecosystem increases the more one looks, the same is true for trying to implement ecosystem management. How do you manage something that is "more complex than we can think?"

While the characteristics, constraints, and opportunities selected by the group were important, the lively discussion that ensued after the lists were developed was the most visionary. The group found that to implement and deal with the complexities of ecosystem management effectively "WE MUST COMMUNICATE." The level of communication must increase commensurate with the complexity of the ecosystem or the desired goals of ecosystem management will not be achieved. This communication must go beyond the rhetoric of "Ecosystem Management is a Philosophy" to the point where those responsible for implementing it have a sufficient understanding to be able to explain it to others.

From the discussions in this group, communication would need to include a common understanding of terms and people's values, and display a willingness to listen to each other. If ecosystem management is to be effectively implemented, and not just on paper for supervisors and politicians, then a substantial amount of up-front time will be required to bring everyone together to learn how to communicate with each other. This means the agencies as well as the interest groups. This would seem to be an obvious need that would not need to be said. However, even in this group, which had just spent one day learning about ecosystems and their management, it was not until the end of this session, after it completed its tasks, that the participants started to communicate and discover what would be required to implement ecosystem management.

Why this was not specifically brought up during development of the constraints was probably the fault of the facilitator and the structure used for the groups. To paraphrase one participant "Ecosystem management is supposed to be about thinking in new ways. The format used forced us into the same mode of thinking we have always had and the universities are not helping." It could also have been the limited time allocated in the symposium to the discussion "implementing ecosystem management." Regardless of this shortcoming, by the end of the session, the group discovered that if communication is not given priority, ecosystem management will likely never fulfill the desired goals. Every management course or workshop stresses the need and importance of communication, but resource managers too often neglect this because they want to get on with managing the resource. They know what should be done, so they want to be free to get on with it. Ecosystem management includes dealing with the human component, and if communication is established it can meet these goals. If communication is neglected, the number and complexity of natural-resources conflicts is likely to increase in the future as is increased polarization of interest groups.

Break-out Session 2: The Colorado Plateau

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Abstract

Unique features of the Colorado Plateau include aridity and the associated importance of water, topographic control on local ecosystems, large urban centers on the periphery but none within the region, and a combination of resource-extraction industries and tourism. Potential constraints to EM are conflicts in the legislative and administrative framework, inadequate staffing and funding of the agencies, insufficient communication among elements of the public, and the difficulty of achieving large-scale data integration. Characteristics of the region favorable for EM include diversity of expertise available, large number of monitoring and research sites, abundance of data, grass-roots ties to the land, and agency commitment. Needs for implementation are definition of EM, implementation initiated at the local level, and an atmosphere of trust and open communication.

PROCEDURES

The Colorado Plateau working group included individuals who live in, are concerned about, or work in parts of the four-state region shown in Figure 1. The process employed in this working group was to divide participants into seven discussion groups, each comprised of 10-12 individuals. Four questions were posed to each group. Three were the same as those given the other break-out sessions, and the fourth was: "What must be done so that ecosystem management does not just become business as usual under a new name"? Each group discussed these topics and recorded concerns and issues during a 2-hour period. During a final 30-minute period, all individuals met as one group and summarized their findings. Those integrated findings were further summarized in order to prepare Tables 1, 2, 3, and 4.

CHARACTERISTICS OF THE REGION

The group identified 12 key physical and human attributes common to the Colorado Plateau Region (Table 1). Although many of these are distinctive, none was considered to pose an insurmountable limitation to successful implementation of ecosystem management. The primary physical attributes of the region are its aridity, associated importance of its water supplies, and strong topographic control on local ecosystems. Although the region is surrounded by large urban centers, (Denver, Las Vegas, Phoenix, Salt Lake City), there are few population centers in the Plateau. Many of these (Flagstaff, St. George, Grand Junction, Durango, Moab) are growing rapidly. The smaller towns, associated resource-extraction or development industries, and growing tourism industry all have a significant tie to the region's biophysical environment.

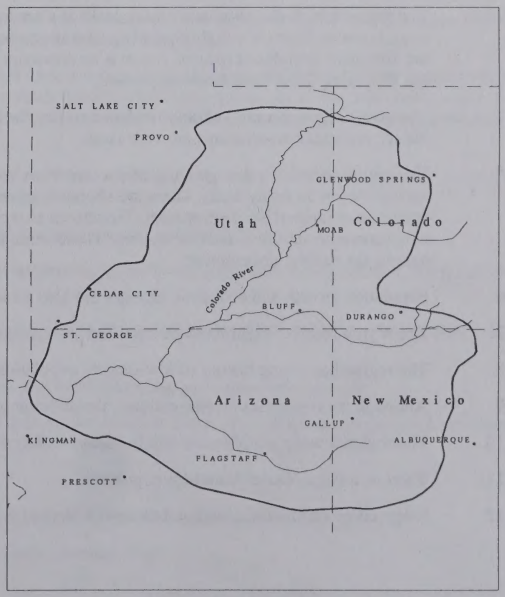

Figure 1. Index map of the Colorado Plateau Province. Redrawn from a base map by C.B. Hunt.

CONSTRAINTS ON ECOSYSTEM MANAGEMENT

Five key barriers or constraints to implementing ecosystem management were identified by the group (Table 2). These are not considered to be unique to the Plateau region, but do constrain the potential for ecosystem management. They range from contradictions and conflicts in the legislative and administrative framework of ecosystem management, inadequacy of staffing and funding of new agency mandates, the need to develop communication links among all elements of the public, and the difficulty of achieving large-scale data integration across the region. High levels of public frustration and impatience with agency decision making further raise the levels of these already substantive barriers. Finally, the group also speculated that expectations about the value and utility of ecosystem management may have been raised so high that they are not achievable.

OPPORTUNITIES FOR IMPLEMENTING ECOSYSTEM MANAGEMENT

There were nine significant opportunities identified that make implementation of ecosystem management desirable and possible (Table 3). These opportunities include those related to the characteristics of the region's populace, land-management agencies, and environment. Ecosystem management was seen as an opportunity to integrate a substantial volume of existing data, establish linkages among interest groups and various levels of government, and take advantage of the region's distinctive environment.

CONDITIONS THAT MUST HOLD IN ORDER TO IMPLEMENT ECOSYSTEM MANAGEMENT

For ecosystem management to be implemented effectively, several key issues must be dealt with. Participants were asked to identify the most important things to which administrators need to give attention (Table 4). Participants felt it critical that all agencies, as well as the public, must agree on a common definition and conceptual framework for ecosystem management. Participants agreed that implementation must begin at the local level, and that local-level personnel and citizens can best identify implementation problems. However, participants also agreed that it is critical for senior-level management personnel to embrace the concept of ecosystem management sincerely.

TABLE 1. CHARACTERISTICS OF COLORADO PLATEAU REGION.

1.	The exterior boundary of the region is well defined.
2.	The region is dominated by its aridity and geology. Streamflows are generated in the high plateaus, "island" mountain ranges, or in the surrounding Rocky Mountains.
3.	The region's high elevation and aridity make it a sensitive landscape, dependent on its riparian areas. Human activities can have large impacts. There is a high level of species uniqueness and threat to these species. Many are threatened or endangered. There are also many introduced species. Aspen is an important vegetation type but is being invaded by conifers—pinyon and juniper areas are spreading. Fires have been suppressed.
4.	The ownership and control of land are dominated by the federal government, but there are significant areas of state ownership. Some Native American reservations are very large.
5.	The region includes a few growing urban centers as well as small towns, many of which are not growing. Population density is extremely low in many areas. There are abundant mineral resources in some areas and available streamflow has been tapped for irrigation or large-scale development. Traditional economic activities of farming, ranching, and mining are now being replaced by new economic activities such as tourism. These shifts are occurring rapidly. Some elements of the population have a strong bias against the federal government.
6.	Population growth and economic changes are also introducing new ideas into the region.
7.	The region receives significant national and international attention because of its scenic beauty and uniqueness.
8.	The region has a long history of low-density population; archaeologic resources are abundant.
9.	Although the region has diverse cultures, the different groups share strong economic, social, cultural, and spiritual ties to the land.
10.	The region's water supplies are highly valued within the region and downstream from the region.
11.	There is a large Native American population.
12.	Large cities surround the region, but are not located within it.

TABLE 2. BARRIERS AND CONSTRAINTS TO IMPLEMENTATION OF ECOSYSTEM MANAGEMENT.

1. The legislative foundation on which ecosystem management is based is inadequate. Some elements of the foundation are contradictory, such as the purposes of state water law and the Federal Land Planning and Management Act (FLPMA). The mandates within some agencies may impact implementation of ecosystem management. There is no mandate to change contradictory institutional missions if they impede implementation of ecosystem management. The missions of different agencies within the same region and their definition of a healthy ecosystem may conflict as may their jurisdictional boundaries.

2. The agencies charged with implementing ecosystem management are undergoing significant change. The task load is increasing but the budgets are driven by small-scale and long-term planning. Staff inertia, and segregation of disciplines within staffs, may be sufficient to impede implementation.

3. The general public of the region has a wide range of socio-cultural values. These groups have diverse historical backgrounds, interests, political agendas, and expectations. Land ownership patterns in different parts of the region are distinct; rates of population growth are very high in some regions. Some elements of this public are polarized and do not trust one another. Some elements of the public are apprehensive about implementing ecosystem management. These factors make effective involvement difficult.

4. There are large data needs, yet scientific achievement on these fronts is lacking. Guidelines have not been developed with which to develop ecosystem- management boundaries. The scientific basis has not been adequately explained to the public. Data available to implement ecosystem management are inconsistent. Research facilities, such as those which might monitor management success, are inadequate.

5. Agencies and the public may be too impatient to permit ecosystem management to be effectively implemented.

TABLE 3. OPPORTUNITIES THAT MAKE ECOSYSTEM MANAGEMENT IMPLEMENTATION POSSIBLE.

1. Many groups can contribute data and expertise to the development of ecosystem management. These include agency personnel charged with implementing ecosystem management, the general public, landowners, and national and international groups concerned about the Plateau.

2. Substantial data and monitoring sites already exist with which to document successes and failures of previous efforts analogous to ecosystem management. Thus, the opportunity exists to develop unified data sets that cross the boundaries of previous studies.

3. Long-term research sites with which to monitor management success can be created in the topographic and ecologic types of the region. Natural barriers define subregions and facilitate smaller-scale ecosystem management.

4. There is a strong grass roots tie to the land, and agency personnel have a strong sense of responsibility to it. There is substantial grassroots support for ecosystem management. The region is not yet divided by environmental issues so the opportunity exists to develop ecosystem-management partnerships involving the interest groups, local government, state and federal agency personnel. Some of these are already in place.

5. Mandates and management objectives make it possible to implement ecosystem management within the context of adaptive management. Thus, the opportunity exists for us to learn by our mistakes.

6. Although there are a few "hot spots" of population growth, there are large areas of limited growth.

7. The present national attention on ecosystem management provides an impetus for its development and implementation, and provides opportunities to fund management and research programs.

8. The wilderness areas and large roadless areas can provide core areas of low human impact on which ecosystem management can focus. Many other areas also have low human impacts.

9. Scientific and management research are yielding new knowledge about implementing ecosystem management.

10. The potential exists to develop ecosystem management strategies that involve multiple levels of jurisdiction without associated loss of jurisdictional authority.

11. There is an opportunity to reintroduce fire.

12. Aspen areas provide an opportunity to apply management (logging and grazing) practices to these lands.

13. Ecosystem-management focus will initiate better sharing of available resource data.

TABLE 4. WHAT MUST HAPPEN IN ORDER FOR ECOSYSTEM MANAGEMENT TO BE IMPLEMENTED.

1. All agencies, as well as the public, must agree on a common definition and conceptual framework for ecosystem management.
2. Implementation must begin at the local level and at the lower levels of the agencies. Money must be directed to these levels to help initiate this work. The focus of many existing programs must be changed. If needed, a structure should be created to facilitate communication among all groups.
3. An atmosphere of trust and open discussion must be maintained so that all parties can work together.
4. A public information campaign must be initiated to convince the general public that ecosystem management is in the public's best interest.
5. Local-level agency personnel and local citizens can best identify any legislative changes that are necessary in order to implement ecosystem management.
6. Senior-level management in land-management agencies must publicly embrace ecosystem management.
7. All land-management agencies must be consolidated within one department.
8. A Plateau-wide ecosystem research service should be developed, and an electronic information network should be established.
9. Reconsider western water-rights policies and statutes to ensure protection of riparian systems which are a critical component of the Colorado Plateau ecosystem.

Break-out Session 3: The Northern Rockies

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Abstract

Four characteristics of the Northern Rockies that are most important to ecosystem management are the large number of high-profile wildlife species, the diversity of ecological types, the rural socio-economic systems that are highly resource-based, and the fire-dependent natural systems. Potential constraints include the diversity of human values, insufficient knowledge about ecosystems, the tendency for political systems to produce solutions that are not ecologically optimal, and the prevalence of a utilitarian growth orientation coupled with anti-government sentiment. Characteristics most favorable for EM are the large amount of federal ownership, abundant research opportunities, a growing public recognition of the need to make environmental progress, and recognition among the agencies of the need for partnerships.

INTRODUCTION

A key challenge confronting ecosystem managers is the often-difficult task of integrating ecological, social, and economic approaches to management which may have incompatible time scales, variables, languages, and decision frameworks (Gerlach and Bengston 1994). In an evaluation of the Forest Service's New Perspectives program, which was an antecedent of ecosystem management, Shands et al. (1993) found that traditional disciplinary perspectives made it difficult to devise integrated processes and evaluate attempts at integration. A disciplinary focus may narrow the range of issues too soon to identify all possibilities. Therefore a purpose of the 1994 Natural Resources Week symposium was to bring together persons from various disciplines to discuss and debate aspects of ecosystem management as seen from their viewpoints, and thereby to gain understanding of how those viewpoints might differ.

A key tenet of ecosystem management is that activities must be adapted to local conditions, and that managers must monitor those conditions closely in order to ensure that unanticipated factors are not directing change in an undesired direction. It seemed important to discuss how factors in the major regions of the Intermountain West—the Great Basin, Colorado Plateau, and Northern Rockies—might produce different solutions or have different effects on standard approaches to ecosystem management. The persons best able to address that issue are the ones who actually manage the land, and who have intimate knowledge of local conditions that might affect the course of ecosystem management.

Accordingly, a half-day session with three concurrent workshops was scheduled in which researchers, managers, and students from around the region could bring their differing skills and experiences to bear on the problems of implementing ecosystem management in three regions. Armed with a common set of ideas about ecosystem management that had been provided by the first day's speakers, participants were asked to consider what ecosystem management would mean in their particular region of interest. This paper summarizes the discussions on the Northern Rockies.

PARTICIPANTS AND PROCESS

The Northern Rockies group included symposium attendees whose primary geographic area of interest was within a region that included Idaho north of the Snake River, western portions of Montana and Wyoming, and the mountainous area of Utah lying north and east of Utah Lake. Numbers of participants fluctuated slightly through the morning, but generally numbered around 45. Participants were generally managers or university scientists, most of whom work in Idaho or the Greater Yellowstone Ecosystem. The session moderator was Rick Reese, a conflict-management specialist who serves as Assistant to the President of the University of Utah. The recorder was Mark Brunson, Assistant Professor of Forest Resources at Utah State University.

As part of the ground rules at the start of the session, participants were asked to focus on three questions of interest without tarrying over the exact definitions of "ecosystem" or

"ecosystem management." Workshop organizers argued that the bounds of those concepts had been generally defined by the previous day's discussions. The questions offered for discussion were:

- What characteristics of the Northern Rocky Mountains region are most likely to affect the conduct of ecosystem management?
- What constraints are managers most likely to face as they implement ecosystem management in the Northern Rockies?
- What opportunities are managers afforded as they implement ecosystem management in the Northern Rockies?

The group was then divided into six sub-groups of 7-8 people each, and these were charged with preparing a region-specific list of characteristics, constraining factors and opportunities. After 40 minutes of discussion within sub-groups, the group reconvened as a whole, and a master list was prepared in round-robin fashion. Once three master lists had been prepared, members were asked to choose the most important elements within each list using a nominal-group approach: placing check marks next to three listed items that they considered most important. After the voting process was completed, and after similar items were combined in a couple of cases, the recorder then identified four features of the region judged most important for each question.

REGIONAL CHARACTERISTICS

The group identified 32 characteristics of the Northern Rockies they believed were relevant to the design of ecosystem-management strategies (Table 1). These were not necessarily unique to that region alone but rather features that, in combination, serve to distinguish the Northern Rockies from other parts of the West or the nation. Roughly two-thirds of the characteristics pertained to the biophysical environment: species richness or composition; availability and character of resources available to humans or to ecosystem components; climate, topography, and water; the role of fire, etc. The remainder referred primarily to human systems for distributing resources or obtaining resource values (e.g., hydropower systems, "crown jewel" parks); the region's relatively sparse human population; and rapid changes in the size, composition, and distribution of human populations within the region. Four characteristics viewed by the workshop participants as most important for ecosystem management were:

- An unusually large number of high-profile wildlife species, including both threatened and endangered species and those (e.g. elk, trout) that are symbolic of wild lands.
- Within-region diversity of ecological types which are often relatively small in extent because of the region's topographic banding of valleys and mountain ranges.
- Socio-economic systems that are rural and highly resource-based, characterized by a quality of life drawn largely from the surrounding natural environment.
- Natural systems that are highly fire-dependent.

In addition to those four, two characteristics that received a fairly high number of votes were the fact that the region is still largely dominated by relatively wild or "natural" ecosystems, and the national prominence of the region's parks.

POTENTIAL CONSTRAINTS

The list of 29 constraints to ecosystem management (Table 2) tended to focus on characteristics of the sociopolitical and managerial environments. These included the utilitarian values and anti-government attitudes of traditional rural publics, and the clash with contrasting value systems of new migrants and non-resident observers; legal restrictions that may limit management options; and a number of features of bureaucratic institutions. Fewer than one-fourth of the identified constraints can be considered aspects of the biophysical environment, and even those were generally expressed in terms of their societal relevance (e.g., limits to water resources *relative to demand*). We posed no requirement that this list be unique to the Northern Rockies, and many concerns were global—especially those related to the public agencies. Four constraints that were clearly of greatest concern to the group were:

- Broad diversity of human values and demands for Northern Rockies natural resources.
- Lack of knowledge about ecological systems at landscape or larger scales.
- The need or tendency for political processes to produce solutions that may not be optimal from an ecological standpoint.
- Prevalence of a utilitarian, growth-is-good orientation toward natural resources coupled with anti-government sentiment.

Other factors that worried more than a few participants were the complications created by a change in environmental values of influential publics; high level of interest in the region by non-resident publics; and a record of inconsistency within agencies between management plans and on-the-ground implementation of those plans.

OPPORTUNITIES FAVORABLE TO ECOSYSTEM MANAGEMENT

The group developed a list of 26 factors (Table 3) which offer opportunities for doing ecosystem management in the Northern Rockies. Many of these were restatements of factors that were listed as constraints. This paradox was noted by several group members, who suggested that such willingness to "make lemonade out of lemons" is indicative of a widespread recognition of the need for a shift to an ecosystem-management approach. The opportunities fell into four broad categories: the wide variety of tools available for ecosystem management, from GIS to environmental education; the relatively simple sociopolitical landscape, characterized by low population densities and large extant ownership blocks; the relatively unaltered biophysical landscape; and an agency climate that encourages ecosystem management. Most of the listed opportunities received only two or three "votes" from the group, but there were four that were considered important by many participants. These were:

- High degree of federal ownership which simplifies the structure of inter-agency partnerships within landscapes or ecosystems.
- Research opportunities at the ecosystem level afforded by the comparatively intact nature of those ecosystems.
- A shift in public attitudes toward recognition of the need for environmental progress.
- General agreement within resource management agencies on the need for partnerships that preserve ecosystems while allowing wise resource use.

LITERATURE CITED

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TABLE 1. INFLUENTIAL REGIONAL CHARACTERISTICS IN THE NORTHERN ROCKIES

Overall biophysical characteristics
Variety and diversity of ecosystems within the region
Diverse physiography
Distinct topographic banding of valleys and mountains
Complex pattern of recurring landscapes
Meso-scale climatic diversity
Relatively high precipitation for the Interior West
Extensive forest cover
Low potential productivity
Ecosystems are primarily natural or "wild," relative to other regions of the U.S.
Ecosystems are highly fire-dependent or -dominated
Fires have been excluded since the era of European-American settlement began
Forest health is a significant concern

Species composition characteristics
High-profile threatened/endangered species
Large populations of "charismatic megafauna"
Significant numbers of endemic or unique flora and fauna
Ecosystems tend to have low species richness at any particular locale

Socioeconomic characteristics
Land ownership is predominantly federal
Rural, natural resource-based socioeconomic systems
Tourism and recreation are economically important
Human population densities are low, on average
Human population centers are clumped and widely separated
Rapid population growth
Lifestyles and consumption patterns are changing
Unique human quality of life

Resource management characteristics
Recreation is scenery- and/or water-based
Richly endowed with valued minerals
Large wilderness areas
High-profile "crown jewel" national parks
High-quality water, with an important role as a water source and storage basin
Rivers are highly impounded and adjudicated (for water rights)
Hydropower is an important resource
Geothermal resources are present and potentially important

TABLE 2. POTENTIAL CONSTRAINTS TO ECOSYSTEM MANAGEMENT IN THE NORTHERN ROCKIES.

Biophysical characteristics
- Systems have limited resilience or plasticity
- Short growing season
- Carrying capacity is low and often already reached

Sociopolitical characteristics
- Diversity of natural resource values and investments
- Myriad and multifarious legal regulations
- Legal restrictions and concerns about threatened and endangered species
- Environmental laws restrict management options
- Ownership patterns are intermingled, creating an overabundance of "edge"
- Fear and uncertainty among public and practitioners regarding ecosystem management
- Local populace exhibits a strong anti-government sentiment
- Conflict between viewpoints of utilitarian conservation and preservationism
- Belief in the "dominant social paradigm" - a growth-is-good mentality
- Changing values among the populations that can influence policy
- Rapid population growth limits opportunity to make decisions
- Non-resident publics have a high stake in the fate of charismatic places
- Access to public lands is often limited
- Tendency to use political processes to reach solutions that may not be the best science

Managerial characteristics
- Systems tend to be stretched to their limits for commodity production
- Region's size and scale are immense relative to human scales
- Settlement patterns and legal issues restrict managers' ability to use fire
- Lack of landscape-level knowledge about the region
- Water resources are limited relative to demand
- Inconsistency between plans and implementation
- High impacts of mining and manufacturing make rehabilitation efforts more difficult
- Lack of partnerships between agencies
- Lack of monetary backing for ecosystem management
- Lack of clear, consistent policy in many federal and state agencies toward ecosystem management
- Institutional environment often discourages creativity
- Agencies have limited skills in public interaction

TABLE 3. POTENTIAL OPPORTUNITIES FOR ECOSYSTEM MANAGEMENT IN THE NORTHERN ROCKIES.

Biophysical characteristics
- Ecosystems are still relatively intact
- Boundaries of ecosystems are relatively "clean"

Sociopolitical characteristics
- High degree of federal land ownership
- Land ownership patterns are less complex than elsewhere
- Influx of new, outside thoughts and values in the public
- Cultural attitude change toward recognizing the need for environmental progress
- Strong public interest in wise resource use
- Lack of large human populations
- Relatively low population density means public involvement tends to be more universal
- Strong public interest in natural systems offers opportunities for environmental education
- Public interest in ecosystem management is high due to the region's resource dependency
- Potential opportunities to pull divergent views together
- Lack of political meddling

Managerial characteristics
- A variety of land management tools are available
- Positive agency attitude toward ecosystem management (especially federal agencies)
- Numerous research opportunities at the ecosystem level
- Opportunities to use large wildernesses as "controls" for ecosystem-level experiments
- Ecosystem management expertise is available in the region
- Able to shape ecosystem management at the local level
- Partnerships can be formed which share common goals and objectives
- General agreement across agencies on the need for partnerships
- Opportunities exist for cooperation across the Canadian border
- Strong, dynamic leadership within the Forest Service and other agencies
- History of doing prototypical ecosystem management (Sustaining Ecological Systems)
- Development of GIS technology
- Land exchanges and easements can be used to protect sensitive systems

SESSION 4. THE AGENCIES' ROLES IN ECOSYSTEM MANAGEMENT

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U.S.D.A. FOREST SERVICE DIRECTIONS

Jack Ward Thomas

ECOSYSTEM MANAGEMENT: A FRAMEWORK FOR MANAGEMENT OF NATIONAL FORESTS

Christopher D. Risbrudt

ROLE OF THE NATIONAL BIOLOGICAL SURVEY

John Mosesso

STATE PARTICIPATION IN ECOSYSTEM MANAGEMENT

Ted Stewart

BLM'S ECOSYSTEM APPROACH TO MANAGEMENT

Mike Dombeck

U.S.D.A. Forest Service Directions[1]

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Abstract

The Forest Service has evolved to a new land ethic: preservation of the function, health, and productivity of ecosystems, including the production of goods and services for people. This evolution is the result of several converging streams including advances in scientific technology, emerging political directions, and realization that problems need to be addressed at the outset.

A number of challenges are facing the move to ecosystem management (EM) including a number of statutory changes or clarifications, declining budgets and staff, and the need to work more closely with the other agencies.

The Forest Service intends to play a leadership role in EM. The decision space for any management approach is bounded by science, political acceptability, social consequences, and economic feasibility. Although the Service has sought public input in the past under the National Forest Management Act, the effort has not been satisfactory. EM requires more collaboration between other agencies, universities, organizations, and interest groups.

We must continue to advance our science. Land managers are being directed to understand the structure, function, and variability of systems to be managed, and their response to use. We have no option but to move forward with natural-resources exploitation.

As government is being reinvented, we are reinventing the Forest Service including implementation of ecosystem management. We need to get away from managing individual resources to focusing on whole systems. This will require more budgetary flexibility and effective monitoring to evaluate management. We need to strengthen the Service's research arm and upgrade the educational level of our personnel. We need to process and assimilate new information more efficiently, move it quickly into operations, and we will be hiring people who specialize in those functions.

We need to strengthen collaboration with our sister agencies and our many constituencies. We recognize the sensitivity of the property-rights issue and seek no additional authority over private property. Our objective is to provide technical assistance to federal and state land managers and nonindustrial private owners. Our goal is leadership into the 21st century in effective resource management.

INTRODUCTION

Since I have taken on this new job, I find that I don't have time to write my own speeches, and I just read the one they wrote for me, and I don't like it. So some of what I will say today will be my speech, and some of it will be saying what I want. In terms of ecosystem management, I look on this as the next step in an evolutionary process. Many people want to look at it as revolutionary. Actually I think it's quite evolutionary. It is an evolving concept. I don't think it has an exact definition nor does it have a set of rules. I hope it never emerges as a set of rules.

A LAND ETHIC FOR THE FOREST SERVICE

I feel that we have finally come to a point where, at least with the Forest Service, our next statement of how we operate and who we are will for the first time be a statement of a land ethic. And that land ethic will be the objective of our management, which is the preservation of function, health, and productivity of ecosystems. That's been a long time in evolution, but I think now is the time that we have evolved to the point where we can state that, not only as an object, but as an ethic.

So is it that complex? Not to me. Ecosystem management merely says that first in our management we take care of the system so it will continue to be productive over much, much longer periods of time than we have conceived of in the past. The next is, "Well, what do you mean by that"? The reply will be "Well, we want to maintain it in a healthy condition." Well, what does that mean? That means being able to absorb insult or shock because we have preserved the parts of that system whereby it can return time after time to a productive state. Not overwhelmingly complicated.

Healthy systems are productive, and that includes production of goods and services for people. We need to be careful with the definition of health. A large part of the definition must include healthy for what? Healthy, in many cases, will require definition.

[1] Editorial note: This is a transcription, slightly edited, from the recording of Dr. Thomas's presentation.

But somebody says, "Well, this is the latest buzzword." You see, I don't think that New Perspectives was a buzzword. I think that in it's simplest context it was merely a permission to people in natural resources to think about it. Just take a new perspective. Is everything we are doing correct? Is it right? Are our paradigms right? Think about it. It wasn't a set of rules.

And in thinking about it we have come down to ecosystem management now. I think we have been forced to it by a number of streams that have come together at this point. One stream is that we've been talking about it, and if you go back and read you will find that we've done so for a very, very long time, perhaps centuries. Certainly we talked about it in those terms in the thirties.

It has almost been like "Goddard in the Rockets." Goddard had the mathematical equations to put somebody on the moon but he didn't have the technology to do it. He didn't have the boosters. Then when he got the boosters, he didn't have the computational capability to compute rapidly enough to make course changes. Well essentially the science in ecology and biology is now doubling at a much more rapid pace. Our ability in geographic information systems, in other mechanisms for storing and handling data, our ability to look at very large pieces of ground at the same time, and our ability to manipulate and project into the future, suddenly all are coming together at a point where we need to do this.

Politically, the time has come to do it. In this country, you know, we've always known everything is connected. There's no free lunch. Suddenly in our generation, now that's becoming very, very obvious. Probably in the United States because of our wealth, it's been forced on us in a strange way, through the application of the Endangered Species Act. Most people who think about it should read the first paragraph of the Endangered Species Act. "The purpose of this act is the preservation of the ecosystem upon which the threatened or endangered depends."

I think the experiences that we've been through in the Pacific Northwest have shown us. We initially set out after a great deal of reluctance to deal with the Northern Spotted Owl with a team that worked on what was called the "Interagency Scientific Committee Plan." We thoroughly believed at that time that we would do our job and either retire or spend the rest of our lives in Pago Pago. We said, "If we are going to do this, let's deal with the real question," which is the old-growth ecosystem or that aspect of the overall ecosystem. And they said, "No, no let's deal with exactly what the law prescribes, and that's the Northern Spotted Owl."

After we finished that approach, it became very clear, very quickly, at least to some people in Congress that it was a larger question. They brought back a group called, "the Gang of Four." Some people referred to us as the four horseman of the apocalypse, but nonetheless, Congress began to say at that point, "Tell me about the system. We can't keep doing this, talk about the system." And as we started out the door congressmen said, "Oh, and by the way, don't let us get caught by some damned fish." Prophetic! Well, we came back with a number of options. But it still was not time to make a decision. Back to the courts. Back one more time. And the President of the United States—a new president gets elected—says, "OK, we are going to come to a conclusion." And now we do have an ecosystem strategy in place.

One thing to be learned out of that entire process is that problems ignored and responsibility delayed will always end up with a worse, tighter economic and social situation. If we have learned anything, it is that we should not delay in addressing tough questions, because the questions just get tougher.

We will see where we go with that one, but basically in the end we want to look at ecosystems in the most pragmatic sense. You could look at them if you were a pragmatist and you could say ecosystems are the geese that lay golden eggs. The first rule of continuing the production of golden eggs is keep the goose happy. Keep the goose alive. Keep the goose functioning and that's the pragmatic aspect of ecosystem management. If you view it from the idealistic, the spiritual, and the more inclusive side, you could say the goose has intrinsic value, in and of itself, and the golden eggs are nice. I don't care which way you go at it. It ends up in the same place.

MAJOR CHALLENGES CONFRONTING US

So given that as a preamble, we're looking at several areas where we need to change our current policies to implement ecosystem management. There's going to be a need to change our statutory framework. We know that we're going to have to change our regulations and we're streamlining those land-management practices. We have simply got ourselves bound up in bureaucratic process that is absolutely paralyzing, and we are essentially grinding to a halt in our own bureaucracy. The Forest Service will take care of its own regulations soon and we should present those changes in '94 sometime. We also operate under a number of natural-resource laws that are somewhat confusing and conflicting to say the very least, not only the legislation itself but the evolving case law. For example, we have a case you read about in the paper called the Sweethome Case, where in the East they said alteration of habitat on private land cannot result in a taking of a threatened species. That's interesting because there is an opinion in Ninth Circuit on the west coast. This says exactly the opposite. So not only do we have some conflicts in law, we certainly have some developing conflicts in case law. We are working with the Office of General Counsel looking at those existing laws to see if there is some way that we can implement ecosystem management more effectively.

One of the things I have found after stepping into a job like this is that I wanted to deal with the great natural-resources issues of our time. Instead I sometimes feel like I am being nibbled to death by ducks. I have found to my great shock that instead of spending most of my time with scientists, I spend most of my time with attorneys trying to make sure that we are in compliance with the law and moving forward effectively and efficiently. And our attorneys continue to tell me "Well, maybe we are going to make it, but you should realize that in trying ecosystem management, you are diligently pounding round pegs into square holes. The law wasn't designed for it exactly and as a result we have a lot of chances to stub our toes."

Now we will also require that all of our processes and activities will involve the public and other cooperators in implementing ecosystem management. But there is a problem. That problem is called the Federal Advisory Council Act, FACA. It really presents a challenge in how we are going

to deal with getting that pro-public participation. We have asked the General Counsel's office to help us to comply with the Act and still conduct our extensive public participation, and we are having real difficulty. For example, one problem is a number of the partnerships that we consider absolutely obvious due to legal obligation and long-standing methods of operation. Some of our attorneys even tell us we can no longer consult with the state game departments without a full-blown FACA committee operation of which they are only part. Same problem with state foresters and Indian tribes. Others say well maybe, maybe not. Well, the risk of making a mistake is an injunction, and we are diligently trying to escape injunctions. So we will continue along these lines fairly quickly, but it's a tough, tough situation.

Now we also face challenges — and it's not just us, but other federal agencies — with declining budgets and staff, and we are working on the development of techniques to support ecosystem management and agency-wide implementation. But it's going to require significant adjustments in the way we collect information, establish our analytical tools, our planning processes, our field actions, and our monitoring activities. And that takes adjustments in work-force skill and institutional process.

Now the first thing you teach in a management book is, "You're not going to be around long when you take over something like this. Pick one or two things you want to make work and concentrate on those." I wish I could do so. There are about seven things bearing down on us simultaneously that we have no option but to address.

Downsizing. Last week the U.S. Forest Service had 2,300 people retire. We lost 69,000 years of experience in one week. We anticipate losing another 30-40,000 years of experience next year. That's on top of what we have already done.

We have a team working called the Reinvention Team, part of Vice-President Gore's reinvention of government. They are looking at how we can best use the U.S. Forest Service, its organization, its people, and its operations to get into ecosystem management. That's going to require a significant staffing adjustment. We are going to have to retrain a number of people and we are going to emphasize ecosystem-management skills in the hiring of new employees.

Presently, we're sharing critical skills between the Forest Service units and other federal agencies. We will rather soon try to get the best balance across government that we can. One of the encouraging things was that we were recently told by the President that he wanted one government responding to our environmental questions and our management questions. No more of the BLM and the Forest Service having divergent management. No more Fish and Wildlife Service arguments from the outside. Those agencies are to combine forces to be more effective, more efficient to serve the American people. I think we can say that that's well underway.

Now, it would appear logical to anyone that if you were going to exercise a new type of management called "ecosystem management" you would then figure out what that is. You would then reinvent your organization in order to carry it out. Then you would downsize your organization, if necessary, to meet budget requirements along that line. Then you would execute it. Unfortunately, we had to downsize first, reinvent second, and then cut to match and fit. We're going to do that, but it's not particularly easy.

GETTING ON WITH THE JOB

Now we fully intend to play a leadership role and I fully intend that we be the premier conservation agency in the world and fully develop an ecosystem-management approach. That also includes, very clearly, human interactions. Ecosystems do not exist independent of people. If we look at any management approach, the decision space is bounded by science, by political acceptability, by social consequences, by economic feasibility. Anything that is outside of that space won't stay there very long. It will erode. So in the past, we have had great direction under that National Forest Management Act for receiving and considering public input into our decision making. We have tried very hard. We are not at all satisfied that we have done that very well. What we have managed to do is produce a cacophony of sound that is so confusing that we can't determine what it is that we've heard except that it is very confusing and opinion is very, very split.

We need to make a new start with ecosystem management. We need to start to work on what we can agree on and work from there instead of concentrating so heavily on what we disagree about. This is going to require an ecosystem management involving a much more collaborative effort, with other agencies, with universities, with organizations, with interest groups. In the short term, we need to continue development of essential tools and techniques. I'm not worried about that. We are well on the way. Trying to learn how to use it is going to be the next thing. The technology is essentially there. We've been shifting very quickly toward consolidating the best available understanding and knowledge about resource management, values, and human interaction. We're moving ahead with that ecological approach that focuses on long-term sustainability of the system, of the environment, of the economy, and of communities. A lot of these issues are still very highly controversial, but I think ecosystem management might provide some better basis of tracking these problems and to view and understand the issue as we go towards a sustainable solution.

Now, to carry out ecosystem management, our land managers are being directed to understand the structure, function, and variability of systems to the extent they can, and to develop appropriate site-specific management activity. One of my favorite quotes that stuck in my mind from long ago though is "Remember that ecosystems are not only more complex than we think, they are more complex than we can think." But we can't let that paralyze us.

We have no option but to move ahead with natural-resources exploitation. That's not a question. We must exploit ecosystems to live. The question is how and under what set of rules. And it would behoove us to look at what's happened around the world where systems have been exploited for a very long time and have collapsed in the process. This would give us some clue as to how much restraint we should use to achieve sustainability, to leave a little slack for caution, for mistake. Through it all, we need to recognize that we don't know all we need to know. We must move ahead with it, but it behooves us to be more cautious then we have been in the past.

We've developed an ecological unit framework that will provide our scientific basis. That framework starts off as a classification and mapping system, stratifies areas into units of common biological and environmental conditions. Those include climate, physiography, water, soils, air, natural communities, and then the people communities, the cultural communities. We've been working closely with other federal agencies so that we can have a unified approach.

In looking at the broad directions and programs that you can expect to see in the agency, one major initiative stands out. It is what we call the Forest Service Reinvention Team. This is a project to reinvent the Forest Service, how it looks, how it's organized, what key functions ought to be addressed by the Washington Office, how the agency will prepare for the next century, and how the Forest Service develops and implements ecosystem management. All of these will evolve in some degree from this effort. I expect a final report this fall; however, I expect a report that we can start to operate on by June. Based on what we've learned and done today, the thinking is currently going on.

Some of the changes that can be expected as a result are: As an agency we have to move quickly now to successfully implement ecosystem management. Successful implementation will affect more than how we manage national forests and grasslands. It will also change how the Forest Service interacts with other land owners, how we are organized, and how we request and allocate resources. This will not be an easy thing to do. In essence we have to move out of functionalism: i.e., managing specifically for wildlife, fish, range, forestry, and watershed. This disciplinary approach has achieved some success, but too often those entities have come into conflict in ways that could be avoided with the cooperative effort that ecosystem management consists of. We have been trained in the disciplinary specialties. The universities trained us to do that. We organized the Forest Service in order to emphasize those disciplines and that was very useful, but now we have to evolve into another way of thinking. It will be difficult. It will be difficult to retrain our people to think in broader terms. It may be somewhat difficult to get the universities to let go and begin to train in a broader fashion. It will be difficult for our constituencies.

We will have to budget differently. We in the Forest Service, like the other federal agencies, have line items. We get so much money to do this, and so much money to do this, and so much money to do this, with very restricted ability to shift money between these pockets. In order to do ecosystem management, we need more budgetary flexibility and fewer line items. Our constituency groups, due to distrust which sometimes has been well deserved, insist that we need more line items. How Congress will fit into this, I don't know, but the line item is the mechanism whereby you can micro-manage a very large federal agency. I think we're making progress, but I don't think our problem is going to be in Congress. I think our problem is going to be with our constituency groups to cut us some slack and to give us a little more trust and support. Well, ecosystem management is a term that is in vogue but too little understood. Systems that exist in our environments are very complex. It's unlikely that we will ever completely understand how these systems work. Probably we never will, but we've learned a great deal. We've got to move quickly now to develop tools to measure health and vigor of forest and rangelands, and to develop and implement strategies that truly conserve biological diversity, maintain aesthetic values, and produce needed commodities.

We've already employed ecosystem-management principles in a number of situations. One is the northern spotted owl, which has evolved into the old-growth ecosystem question of the Northwest. Another is the ongoing Eastside Ecosystem Health assessment which for the first time will throw BLM and Forest Service planning across an entire eco-region simultaneously. That is a big move toward ecosystem management, and this kind of collaboration turned up some shocking insights about ourselves. As far as we had come in land management, we suddenly realized, under the pressure of having to plan together in the Northwest, that we couldn't even make our maps fit together between national forests, much less the maps between BLM and the Forest Service. So we've made great progress there.

Now, a key element of ecosystem management is consistent monitoring and evaluation of that management and its outcome. "Did we perform what we said we would do?" Where necessary this evaluation is used to adapt management to incorporate new information. Monitoring cannot continue being treated as an appendage that may or may not be done depending on future funding. In the past, frankly, we have proposed mitigation for risky courses of action by promising rigorous monitoring and mid-course corrections if our assumptions were wrong. We have not always carried out the required and promised monitoring, nor have we been funded to do so. That has to change.

The underpinning of good resource management always has been, and will continue to be, science. But in implementing ecosystem management, we've got to enhance the use of science in the decision making process. This contribution of science to better decisions will require continued and strengthened independence of the Forest Service research arm, development of guides for collaboration between scientists and the decision makers, and the continuous upgrading of technical skill in our work force. We are quickly moving beyond the point where a bachelor's degree is sufficient background for the complex job of ecosystem management. The people sitting in ranger district or regional offices will need to continually upgrade skills.

We are also coming to realize that our practitioners on the ground simply do not each have the time to synthesize the incredible amounts of information that are beginning to emerge. I look for the evolution of a new specialty. Some of us have done a lot of it but it hasn't been highly regarded as science. I think that will change. I think we will have people in the constant process of synthesizing scientific information into useful packages and then the upgrading that information. I think that will become a recognized and highly valued sub-specialty in science. Equally important, is the technical aspect and the changes that we have to make in order to do our job.

More than ever we recognize that collaboration is required. We've got a rich tradition of using partnerships. For example, we've developed more than 12,000 ongoing relationships with a host of outside interests. They include sister agencies at all levels, universities, colleges, rural communities, organizations like the Nature Conservancy, and others, but we have to

do more because those relationships are like my fingers. But again, they are related to the sub-specialties within the Forest Service.

The big challenge is going to be how we will coalesce around those things to get the collaboration that we need. We've got to institutionalize collaboration. We've got to have forums where reasonable people, environmentalists, industry reps, recreationists, other government officials can come together to discuss issues, learn from one another, work toward a consensus. We have to bypass the gladiators who get paid to fight the fights. They do not get paid to collaborate. They do not get paid to compromise. They get paid to win. I think the people who will institutionalize this collaboration are those people who are slightly inside of those gladiators.

We have begun to see some examples. We have worked with communities that were so split at the beginning that they knew something had to be done: "My God, we've destroyed ourselves. My God, we have destroyed ourselves." And then they began to come back together and say, "We must do something. Not the government. We must do something." And to our credit, we said, "Try. We'll help. Work it out. We'll help. If it looks good, we'll help. What we tried to do in the past didn't work very well. Maybe there is another way to do this. We'll help. We'll listen." In that I find great encouragement, because we stand on shaky ground where we simply cannot continue to stand.

Now an example of the type of changes is a recent direction to eliminate traditional targets in our budgeting. For example, in the 1994 budget allocation there are no traditional timber targets. Rather than assigning and funding timber targets, the foresters are asked to meet timber goals that are appropriate and attainable, given the land-stewardship objectives. They have also been told that the standards and guidelines that apply will be given first attention, then they will strive to meet some level of timber objectives.

We expect to continue to accelerate our emphasis on quality wilderness management. We expect increases in our fish, wildlife, recreation, and watershed- protection operations. We are going to look at our fire management in light of broader ecological objectives and to design incentives to achieve stewardship on non-public ownership. In all cases, we have to evaluate these component programs carefully to assure that they are realistic to implement and provide gains toward the desired outcome. Finally, the program has got to be designed to incorporate new knowledge more rapidly than we have in the past. New knowledge must be moved into implementation and proactive changes made rapidly if ecosystem management of natural forests is to meet the needs of the future. Gone are the days when we can absolutely sit down and believe that we can do a forest plan that would stand for 15 years. I would expect any forest plan that we finish in the futureand I hope we can do them short of two years of effortto be readjusted again within two years, and again within two years. As we try things that work and don't work we have to adjust.

We're participating in a coordinating committee with BLM, Fish and Wildlife Service, National Park Service, Defense, and Nature Conservancy to promote the use of research natural areas. We are working with BLM to develop parallel land-planning operations. In the past, we have led ourselves into disastrous consequences by BLM and the Forest Service splitting the blanket and running in two different directions when we had a tough management problem to look at. It essentially spun us into chaos. I think those days are over and I think that will greatly improve the coordination of our plans on both the national forest system and the other public lands. Ecosystem management includes a commitment to working with even more partners than we have in the past. Because ecosystems cross boundaries, many federal, state, and county agencies, tribal governments, private land owners, community leaders, and corporate foresters are interested in ecosystem management.

We recognize, however, the sensitivity of the private property rights question and the questions about how ecosystem management can be implemented across boundary lines. Please hear me clearly. We seek no additional authority over private lands. Let me repeat that. We seek no additional authority. Our objective is to provide technical and financial assistance to federal and state land managers and nonindustrial private owners. We've been doing that for years through state and private forestry. I think our job is to develop the technology, the approaches, the information, the synthesis of how we do ecosystem management and then make these available to those of our neighbors who wish to join with us. I think there will be many.

Our long-standing partnerships with federal land managers, state foresters, nongovernment organizations, local officials, and land owners in many cases have developed very strong and successful working relationships. Those relationships foster ecosystem approaches at every level to achieve sustainable forests as well as sustainable communities. The state foresters work independently of the national association and are major partners in delivering programs at the field level. But there is ongoing coordination with the national associations that represent local community groups, like the National Association of Counties, and the National Association of Conservation Districts.

To end, I think we have come to a moment in natural resources management, particularly in forest management and public-land management, that has not existed since the early 1900s. The stars are aligned, the technical ability exists. I think a new understanding exists. A political situation exists. A condition of economic gridlock exists that opens up a window which we can step through into the 21st century with the most exciting moves since in the early 1900s. However, I do not believe that window will remain open for long. There are people who are pounding at the boundaries of that window now to shut that gap, to close it. There are always those who are afraid of the future. There are always those who have investment in the past. But if you look at the world situation, our population, our knowledge, we simply cannot stay where we are. We have to move through that gap, and if I can do one thing during my tenure as Chief of the Forest Service, it will be to help go through that gap and put the Forest Service in the leadership role I want it to achieve as we go into the 21st century.

Ecosystem Management:

A Framework for Management of Our National Forests

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Abstract

The USDA Forest Service has altered its traditional method of land management to include the concept of ecosystem management (EM) while not discounting or changing its mission for multiple use. It requires that ecosystem considerations be factored into every aspect of natural-resources management.

EM incorporates concern for biodiversity, and application of ecosystem and landscape concepts in resource management. It increases use of scientific knowledge in the management of natural resources, and an understanding of processes that cause change and how they affect and are affected by the activities of people. Demands placed on ecosystems by man have been significant and have changed the landscape, some recently, others over centuries. EM responds to human dependance on ecological systems by insisting that ecosystems be kept resilient and capable of recovery after disturbance.

Understanding landscape dynamics and ecological processes is key to EM planning efforts. It is necessary to understand how ecosystems are arranged spatially on the landscape and how they are connected—how materials and energy flow between them and how one ecosystem influences another.

Photosynthesis by green plants drives all ecosystem processes. Accumulation of biomass on the landscape through the 20th century and fire-management policies have caused a problem in the Northern Rockies. Success of the Forest Service in firefighting has resulted in a disturbance regime unlike what forest species adapted to over the past 10,000 years. As a result, forest composition and structure in the Northern Rockies, and associated fuel patterns, have changed. The ecological consequence is that fires can have a dramatically different outcome than they did prehistorically. With fewer fires and increased fuel loads since settlement, fires now have a more devastating effect on the landscape.

Key to EM is conserving biodiversity. The approach selected by the Forest Service is a multi-faceted strategy that emphasizes managing regional-level landscapes within natural system variation. Managing ecosystems and landscapes, conserving biodiversity, and producing goods and services for mankind requires that land managers analyze ecosystems at much broader scales to achieve these goals. The more landscapes are kept near or at their range of natural variability, the greater the potential for maintaining sustainability.

The only way to achieve an understanding of ecosystems and gain acceptance for this style of management is with a team approach, where everyone has an opportunity to understand and participate in the development of EM strategies.

INTRODUCTION

Although ecosystem management (EM) may not yet be a commonly understood concept by the public, it is having a significant impact in government circles. The President of the United States talked about EM in his Forest Plan for the Pacific Northwest. The Forest Service has adopted it to guide the agency in its management of national forests and grasslands. Since the Forest Service administers 191 million acres, making it the second largest federal land manager after the Bureau of Land Management, EM is making its influence felt.

EM does not change or discount one of the principal missions of the Forest Service, which is management of land for multiple uses. The difficulty for land managers has been choosing which uses and values to favor and which values to limit. Clearly, the national forests cannot accommodate all demands from the public at the levels desired, nor can it be expected that public demands will remain the same. Society's expectations are changing, with greater insistence that ecosystem considerations be factored into every aspect of natural-resources management.

In response to these changing needs and demands, the Forest Service has adopted the EM approach to provide a

stable foundation for management based on sound ecological principles. This framework for management refocuses on the "sustainable" part of the Multiple Use, Sustained-Yield Act which became policy for the regulation of national forests in 1960. There is a greater emphasis on decisions with a view to the future, promoting sustainable production over the long run. This approach recognizes the limitations in short-term solutions at the expense of long-term sustainability. It is an approach to land management that places the productivity of resources in the context of desired conditions for ecological systems.

EM incorporates management for biodiversity and the application of ecosystem and landscape concepts toward resource management. It requires not only the increased use of scientific knowledge in the management of natural resources, but an understanding of the processes that cause change and how they affect, and are affected by, the activities of people.

A DIFFERENT APPROACH TO LAND MANAGEMENT

Human cultures have developed within ecosystems and are sustained by them. People have impacted all ecosystems. Some impacts are recent, others have endured for centuries. The long-term well being of humans depends on sustainable ecological systems, requiring that we keep them resilient and capable of recovery after disturbance. Because of the dependence of the world's population on ecosystems for survival, and because of the agency's Congressional mandate concerning multiple-use, the Forest Service does not manage ecosystems for the sake of the ecosystems alone. Ecosystems are managed to produce the goods, services and values people need. Under ecosystem management, land managers will still provide opportunities for recreating, grazing livestock, harvesting trees, and all the other uses of the national forests and grasslands.

The key differences between EM and more traditional management are: (1) understanding the dynamics of natural systems; (2) assessing and managing at various temporal and spatial scales; (3) a strategy for conserving biodiversity; and (4) more consideration of ecological functions.

One of the first problems faced by land managers is defining an ecosystem. Simply, an ecosystem is a community of organisms and its environment that function as a whole. Forests are ecosystems, but so are ponds, rivers, rotting logs, rangelands, whole mountain ranges and the planet. Ecosystems occur at many scales, from micro sites to the biosphere. Ecosystems include interdependent plants, animals, people, the physical environment, and the ecological processes that link them.

Forest Service managers have traditionally looked site-specifically at stands and timber compartments. They have followed the scientific process of breaking large problems down into small, understandable ones. In making our decisions at the smaller scale, we have more or less accepted the consequences at the larger scales. Looking at the smaller scale forced us to consider the cumulative effects of our decisions.

In EM, land managers make decisions at the larger scale and accept more of the consequences at the stand level. This is a significant change in decision making.

ECOSYSTEM CHARACTERISTICS

The science of landscape ecology involves three basic components of landscapes or ecosystems--composition, structure and function. Composition and structure are what we can see in a landscape. Function relates to energy processes such as fire, hydrological processes such as floods, and matter and energy exchange through the food chain.

To understand ecological processes and landscape dynamics, it is necessary to look not only at ecosystems and how they are spatially arranged in the landscape, but also at how they are connected—how materials and energy flow between them, and how one ecosystem influences another.

Photosynthesis by green plants drives all other ecosystem processes. It is the primary process that produces biomass, the amount and type of which changes through time. Most forest ecosystems produce about one ton per acre of new green biomass each year.

NATIONAL FOREST FIRE MANAGEMENT IN AN ECOSYSTEM PERSPECTIVE

In the Northern Rockies, and throughout the Intermountain West, we are struggling with the accumulation of biomass on our landscapes. Some preliminary estimates show that we have one-third more biomass per acre today than we had in the past 10,000 years—since the end of the Ice Age. The current accumulation of biomass is well outside the range of natural variation. Over the past 50-60 years, the composition and structure of our forests has changed to conditions unlike those at any time in the past. In our relatively cool and dry environment, biomass does not decay as fast as it accumulates. Fire is the major agent that processes this accumulation.

One of the biggest impacts Europeans have had on western forests and ecosystems is the change in fire management that occurred after the turn of the century. In fact, that is one of the reasons the Forest Service was created. The Forest Service's reputation was built early-on through firefighting and it is still based on this practice to a large degree.

Through our management actions, we have been changing the fire cycle. Since 1908, the Forest Service has extinguished 72,000 lightning-caused fires, and 34,000 person-caused fires (Figure 1). If these fires had continued without interference from Europeans, the landscapes of the Northern Rockies would look considerably different. As a result, we are in a different kind of disturbance regime than the one to which the forests adapted over the past 10,000 years.

To describe how composition and structure of our forests have changed, we need to look at fuel models. The Forest Service has developed 13 fuel models that represent different conditions and enable us to predict wildfire behavior more effectively. These models can also be used to describe how our forests have changed over time. For this discussion, we need consider only four of the 13:

(1) Fuel Model Two—an open, park-like stand of large trees with a single overstory. Grass in the understory burns fast, but at low intensity and does not kill the overstory trees.

(2) Fuel Model Five—young tree and shrub successional stage with a moist, green canopy. Even in August, these fuels generally do not burn. In drought years, fires in this vegetation type will typically creep around and go out.

(3) Fuel Model Eight—sapling and pole-size trees with little dead standing and fallen wood. In a normal year, fire in this fuel type generally would not spread to the crowns of overstory trees, but will thin out stands. However, in drought years like 1988, tree canopies become very dry in August and September and can burn with a crown fire.

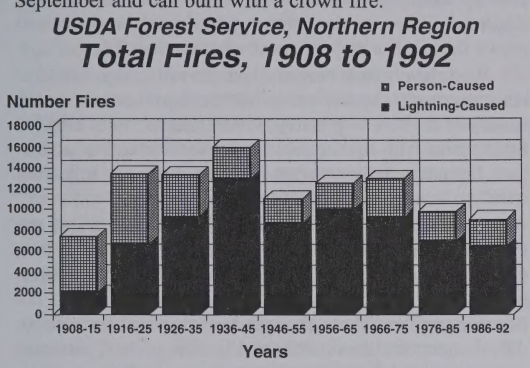

Figure 1. Number of forest fires occurring in the Northern Region of the USDA Forest Service, 1908-1992.

(4) Fuel Model Ten—large trees in the overstory and layers of small and intermediate trees in the understory with dead standing and dead down fuels. Crown fires can occur in this fuel model in any normal year due to dead fuels and understory fuel ladders, and will burn at high intensity in drought years.

Prior to European settlement, nearly half of the south-facing slopes could be represented by Fuel Model Two, and most fires occurred in this type (Figure 2). When fires sweep through Fuel Model Two forests with normal frequency, they process the biomass, preventing large amounts from accumulating. Today, however, the forests have changed to conditions represented by heavy fuel models and fuel loads. Now, when a fire occurs, the fuel ladders carry the fire into the crowns of large trees and the trees are killed.

The ecological result from a fire in a forest represented by the heavy fuel models is different from what would have taken place on these same slopes 100 or more years ago. What has occurred in these habitats is a change in conditions from open, park-like environments to predominantly Fuel Models Eight and Ten. The disturbance regime has changed from frequent, low-intensity surface fires in the park-like stands to high-intensity crown fires in the closed, multi-layer forests. The former were not lethal to the overstory while the latter are (Figure 3).

Cool and moist north-facing slopes—dominated by larch, lodgepole pine, and subalpine fir—present a different situation. Because of the moisture and temperature regimes, there has always been a high percentage of tree cover on these aspects (Figure 4). We are not as far outside the range of natural variation in tree cover on these slopes as we are on

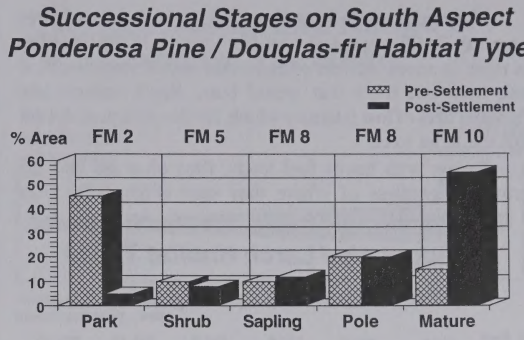

Figure 2. Estimated percentage of land area, both before and since European settlement, in five habitat types on south-facing slopes of the Northern Region of the USDA Forest Service.

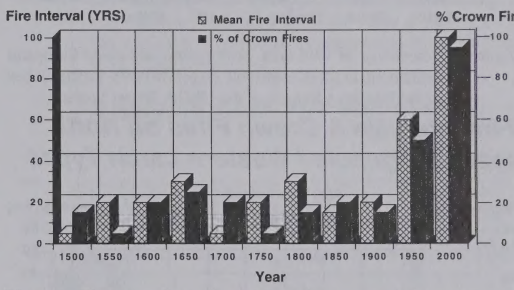

Figure 3. The mean forest-fire interval in years, and the percentage of fires that crowned, on south-facing slopes of the Northern Region of the USDA Forest Service, 1500 A.D. to the present.

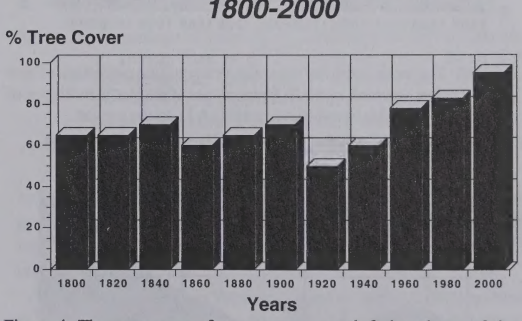

Figure 4. The percentage of tree cover on north-facing slopes of the Northern Region of the USDA Forest Service from 1800-2000.

south-facing slopes. However, by changing the fire cycle, we have significantly changed other features of forest composition and structure (Figure 5). North aspects had spotting and creeping fires in areas of light, moist fuels and crown fires in patches of heavy, dry fuels. Because of the accumulation of more dead material in recent decades, continuous crown fires have resulted (Figure 6).

To summarize, prior to European settlement forest fires on north slopes were patchy, and there was very little burning in riparian zones because of moist and cool environments. A tree here and there that would burn. South aspects had frequent fires of low intensity which, for the most part, did not kill the large trees.

Today, with heavy fuel loads, fires often go into the crowns regardless of where they start (Figure 7). Fires generate so much energy that they dry out riparian zones and burn entirely across them. That did not happen prehistorically to any large degree in the Intermountain West. It is a very different ecological result from what happened in the past. Such fires actually kill fish in some cases.

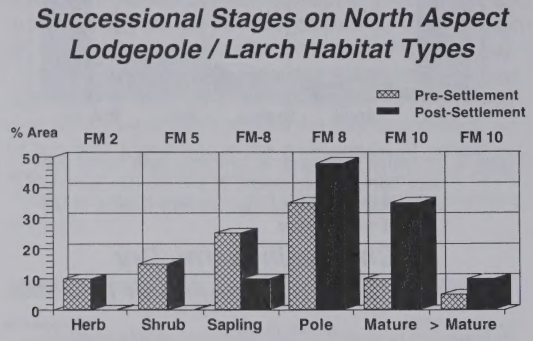

Figure 5. Percentage of land area, both before and since European settlement, in six successional stages on north-facing slopes of the Northern Region of the USDA Forest Service.

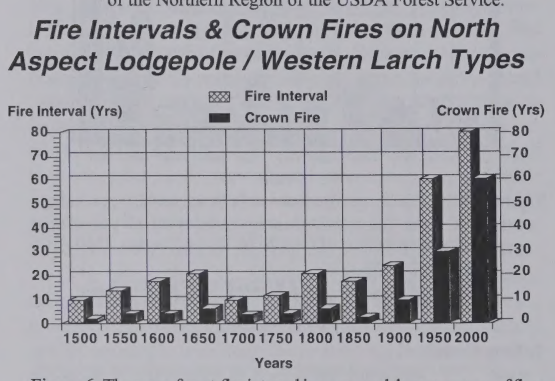

Figure 6. The mean forest-fire interval in years, and the percentage of fires that crowned, on north-facing slopes of the Northern Region of the USDA Forest Service, 1500 A.D. to the present.

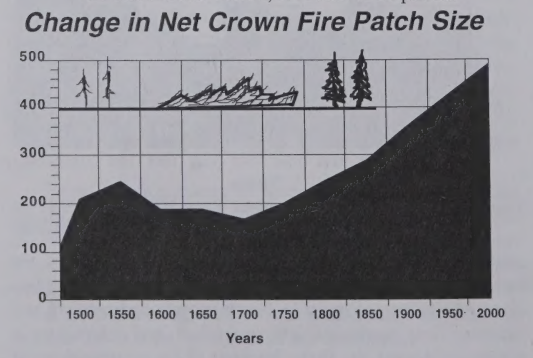

Figure 7. Average size in acres of patches created by crown fires in the Northern Region of the USDA Forest Service, 1500 A.D. to the present.

As a result, the pre-Columbian mosaic pattern of forest vegetation is lost in all three environments: north- and south-facing slopes and riparian zones. Riparian areas are very important for wildlife and fisheries habitat, and for travel and security areas. So are open park-like, south aspects and ridgetops. When we lose the vegetation in these areas to crown fires, it is a major impact on many species.

When heavy fuels burn and heat the soil to high temperatures, the result is hydrophobic soils. Such soils cannot absorb water and the resulting heavy runoff induces major erosion. Small areas with hydrophobic soils were natural in prehistory, but not as large as what we often see today following wildfires in areas of heavy, continuous fuels.

It is obvious that we have dramatically changed the landscape because of our fire- management activities. In fact, it can be argued that the largest human impact on forest ecosystems in the Rockies has not been timber harvesting, but fire management. These changes have occurred because we did not understand the structure and function of pre-Columbian ecosystems, and the ecosystem consequences of our management decisions.

Today, the wildfires that land managers are facing are often of a type for which we do not have the technology, manpower, or equipment to control. Often these fires occur in areas with human development where it is very difficult to save houses and other structures from loss. Given enough fuel accumulation, we no longer ask whether we can put out a wildfire, but how hot it will be, how extensive it will become, and how many houses and other resources will be lost?

BIODIVERSITY CONSERVATION STRATEGIES AND ECOSYSTEM MANAGEMENT

A key goal of EM is conserving biodiversity, commonly defined as the variety of life and its accompanying ecological processes. The scientific community has developed several conservation strategies or approaches.

The species approach uses the Endangered Species Act to emphasize recovery of species once they become rare and in danger of extinction. The approach is important to the recovery of rare species, but is not pro-active at keeping other species from becoming rare.

We spend a million and a half dollars each year on the grizzly bear alone in the Northern Region of the Forest Service, an area encompassing the states of Montana, northeastern Idaho, and portions of western North and South Dakota. There are some 600 species listed under the Act, and another 3,600 species that are candidates for listing. Thus the species approach is potentially a very expensive strategy, and we are looking for a better one.

A second approach, the indicator-species approach, is oriented to selecting a species that indicates the health of a group of associated species or connected habitats. The theory

is that if we manage for the indicator species, all associated species will be conserved. However, it is very difficult to pick one or two good representatives species. Tracking numbers of selected species also does not reveal everything we need to know about ecosystems.

The ecosystem-function indicator approach is based on selecting an indicator of functional habitats, such as snags or community features that can be monitored, and associating their status with that of dependent or coexisting species. This approach has some of the same characteristics as the indicator-species approach, although it has a closer relationship to ecological functions and processes.

The natural-community-representation approach was developed and implemented by the Nature Conservancy, and by public land-management agencies in land- management allocation to natural areas. This approach emphasizes maintaining a complete array of ecosystems and managing them for natural composition and structure. It is a sound approach for conserving a multitude of species and ecological relationships, but it is often the case that not enough lands can be set aside to preserve entire ecosystems.

The ecosystem-management approach is advocated by the Ecological Society of America, the Council on Environmental Quality, and the USDA Forest Service. It is a multi-faceted strategy that includes all of the aforementioned approaches and emphasizes managing regional-level landscapes within natural system variation. It will conserve the species that are native to those landscapes.

It is important to understand natural system dynamics and how they relate to the various conservation strategies. If we manage landscapes within the range of natural variability, we will conserve the species that are native to those landscapes.

MANAGING WITHIN NATURAL RANGES OF VARIATION

How do land managers go about understanding ecosystems and landscapes? How can they manage them to conserve biodiversity and produce goods and services for mankind? The answer to both of these questions is that land managers need to analyze ecosystems at much broader scales than they have in the past in order to achieve these goals. The more that landscapes are kept near or at their range of natural variability, the greater the potential for maintaining sustainability (Figure 8). To today's forest user, the landscapes dominated by closed forests might look more natural. However, we know fire will eventually play its role and affect changes on the landscape whether managed by man or not.

A disturbance-regime analysis may tell of a need for change in management. For example, an area or landscape of lodgepole pine with a mix of 60 percent ground- and 40 percent crown-fire environments is within the natural range of variation. Due to fire exclusion and accumulation of fuels, the majority of the landscapes in the Northern Rockies have now shifted to a crown-fire environment (Figure 9). The landscape is now outside of the natural range of variation to which the species in these ecosystems have adapted. If management is continued outside natural ranges, there may

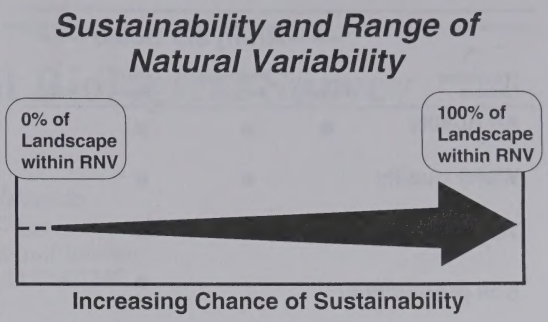
Sustainability and Range of Natural Variability
0% of Landscape within RNV
100% of Landscape within RNV
Increasing Chance of Sustainability

Figure 8. Schematic representation of the principle that the higher the percentage of landscape functioning ecologically in its natural range of variation—i.e. the range within which its component species evolved—the higher the probability that it can be used sustainably to maintain biodiversity and produce goods and services useful for humans. since fire suppression by European settlers, forest maturation, and build-up fuel loads, the extent and intensity of contemporary fires are outside the range of natural variation typically experienced by ecosystems in the Northern Rocky Mountains.

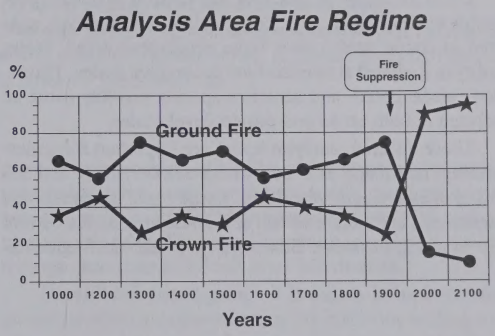

Figure 9. Percentage of forest fires developing as crown fires and as ground fires in the Northern Region of the USDA Forest Service, 1,000 A.D. to present. Prior to fire suppression by European settlers, most of the fires (e.g. two-thirds) were ground fires and only about a third crowned. Since European settlement, crown fires are now on the order of 90 percent of all fires.

be a continued addition of species to the threatened-, endangered-, and sensitive-species lists. A shift in management will be needed in this area to emphasize different stand and landscape structures.

However, whether we manage ecosystems to return them to their prehistoric ranges of variability, or to maintain them outside of those ranges, depends on a host of economic, social, political and ecological factors. These factors may or may not prevent their management within the range of natural variability. In order to address this question, the Forest Service's Northern Region has started a region-wide analysis to address: (1) ecosystem- and landscape-function fire and other disturbance regimes; (2) composition- vegetation types; (3) structure-vegetation patterns.

Ecosystem Element	Analysis Scale: Global	Physiologic Region	River Basin	Stand
Air quality	●	●	●	
Water quality		●	●	
TES viability		●	●	●
Soil productivity			●	●

Figure 10. With ecosystem management, different ecosystem parameters—air quality, water quality, viability of threatened and endangered species, and soil characteristics—are measured and analyzed at different spatial scales.

The objective is to achieve ecosystem management goals by conducting these region-wide analyses, providing tools for site-specific analysis, assisting land managers with an understanding of natural system dynamics, and analyzing environmental, economic, and social costs and benefits.

Different types of analyses are used at different geographic scales (Figure 10). For example, air quality is analyzed at coarse scales over large geographic areas. Water quality is analyzed at intermediate geographic scales. Threatened-, endangered- and sensitive-species viability must be analyzed at both broad and project-level scales.

These different analytic scales are important for understanding landscape and ecosystem relationships and for setting management priorities. Large-scale analyses and assessments are more efficient and effective than the current way of doing business. Biodiversity, or habitat fragmentation, can be addressed once at the larger scales instead of addressing every project on each district.

In summary, the adoption of ecosystem-management concepts and principles commits the Forest Service to make the following changes in its current management approaches: (1) develop broad-scale analyses that consider landscape connections; (2) characterize and consider the range of natural variability for ecosystem composition, structure, and function; (3) promote EM which utilizes all conservation strategies as a "coarse filter" in order to conserve biodiversity.

CONCLUSION

Ecosystem management means building a new basis for managing national forests and grasslands in the Northern Region and other regions of the Forest Service. These ecosystems will be managed as large landscape units rather than aggregates of individual components. What happens at the stand level will, in large measure, depend upon its contribution to the larger system.

The challenges are many. Larger landscapes, with multiple land ownerships, will be most successfully managed with a high degree of voluntary cooperation between landowners. As in the past, there are no other alternatives than to make necessary decisions. There is no time to research all of the questions before EM concepts are applied to the land, but research must play a key role to assist managers in making decisions. Land managers are committed to a learn-as-you-go approach so that future generations have more options to meet their needs in a sustainable way.

The only way to achieve an understanding of ecosystems and gain acceptance for this new style of management is with a team approach, where everyone has an opportunity to understand and participate in the development of EM strategies.

Role of the National Biological Survey

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Abstract

Formation of the National Biological Survey was one of Secretary Babbitt's first administrative acts. The mission of the NBS is to research, inventory, and monitor the nation's living resources, and to provide biological data to resource managers, universities, and other organizations. The ultimate purpose is to anticipate incipient resource problems. The NBS role is non-advocacy, non-managerial, non-regulatory. It will adopt an ecosystem perspective which will integrate ecological, economic, and social principles to promote sustainability, diversity, and ecological health.

NBS will operate on seven key principles: (1) People are part of ecosystems. (2) Diversity and sustainability are keys to ecosystem management. (3) Ecosystems are complex and dynamic. (4) Partnerships are an essential part of implementing ecosystem management. (5) Integrated resource information is essential to implement an ecosystem-management approach. (6) Desired ecosystem conditions will guide management decisions. (7) Good management requires good science.

NBS was formed by moving the biological research, inventory, and monitoring programs and personnel from seven Interior Department bureaus into the new agency. At the field level, NBS will be administered out of four regional offices and operate with 13 Science Centers, more than 100 field stations, and the Cooperative Research Units.

INTRODUCTION

I am pleased to be here today to talk to you about the National Biological Survey, and I thank the Utah State University College of Natural Resources for offering this opportunity to say a few words about the role of the National Biological Survey in ecosystem management.

When Interior Secretary Bruce Babbitt took office in January of 1993, one of the first changes he announced was the creation of the National Biological Survey. He listed the NBS as his "highest priority" and he has defined the NBS mission to research, inventory, and monitor the nation's living resources, and to provide biological data to federal, state, and local resource managers, universities, and other organizations. The Secretary's vision of the NBS is to provide the highest quality science to enable managers to anticipate problems and collaboratively develop solutions that take into account differing interests.

The task of sustaining the long-term health and productivity of biological systems is of critical importance and it requires a clear understanding of how natural systems function in order to make informed management decisions. It seems, however, that for many reasons resource management and science tend to be reactive rather than anticipatory of developing problems. This has resulted in what the Secretary calls "train wrecks," that is, collisions of interests when regulatory tools must be employed to protect a resource, when time has become short and options few. The National Biological Survey hopes to reverse this scenario and in its place provide early warning of habitats and ecosystems experiencing trouble, when many options are viable, conflicting interests can be reconciled, and tempers are cool. NBS seeks to play the role of facilitator and integrator of efforts to collect, manage, and distribute biological information.

Doesn't this sound great? It is sure to be an interesting challenge when you consider that the NBS role will be non-advocacy, non-managerial, and non-regulatory in nature! NBS will be an extroverted agency dealing with numerous organizations and encouraging partnership activities at all levels. Simply put, NBS intends to provide the hard biological-science base upon which other agencies, states, and organizations can base their policy decisions.

Although the focus of NBS is still being developed, it is clear that a new approach to resource management, a broader way of thinking, is in the works. What I am referring to, of course, is an ecosystem approach to biological science. NBS firmly supports this concept and it will be front-and-center as Departmental strategies are developed and in conducting our own research, inventory, and monitoring activities. We recognize that ecosystems do not function along political or bureaucratic boundaries and are not well served by disparate single-mission science. Using an ecosystem-management approach, we believe we can provide resource managers and decision makers the kind of data they need on the status and trends of the Nation's biological resources for making sound management decisions. Through an ecosystem approach, NBS will integrate ecological, economic, and social principles to provide a better understanding of biological systems

and thereby promote long-term sustainability, diversity, and ecological health.

Now, I hope I don't sound as if we believe that NBS has all the answers regarding ecosystem management. Clearly, we do not. Rather, ecosystem management is an evolving philosophy at the NBS and we are just now exploring its meaning and applications with our partners both inside and outside the Department. Although it is likely to be a long time before we have an ecosystem-management philosophy we are completely comfortable with, we are working actively and cooperatively with a large number of agencies on an ecosystem-management process. As a first step we have begun to develop a set of ecosystem keywords that can be used to facilitate conceptual communication and promote common understanding during ecosystem-management discussions.

NBS PRINCIPLES OF ECOSYSTEM MANAGEMENT

We understand that the basic concepts of ecosystem management are not new and we are rapidly coming to agreement on a common set of ecological/ecosystem- management principles that I would like to mention. All of these principles will be familiar to you. What is not familiar is the commitment of an agency to afford due consideration to the principles in its day-to day work.

PRINCIPLE 1

First, NBS recognizes that *People Are Part of Ecosystems*. Biological research has too frequently been focused on individual species and habitats and ignored the human factors associated with them. The ecosystem approach adopted by the NBS will integrate considerations of ecological, social, and economic factors, because we understand that people depend on natural resources for food, livelihood, and inspirational experiences. Human conditions are shaped by, and in turn shape, ecosystems. The needs, desires, and impacts of people must be considered when making resource decisions. We believe that the interaction of people and the physical and biological environment must be in balance. People's actions today determine the future condition of ecosystems and clearly, people are demanding a wider array of uses, values, and products from the land now than in the past.

PRINCIPLE 2

The second principle is that *Diversity and Sustainability are Keys to Ecosystem Management*. This is based on the premise that an ecological approach to resource management promotes long-term vitality and functioning of ecosystems and processes. Sustainability recognizes the fundamental need to preserve the productivity of our soil and the purity of our water and air. It implies a relationship between human economic systems and ecological systems, such that human life can prosper indefinitely while allowing cultures and economies to develop. But it must also be a relationship where the biodiversity of natural systems is not destroyed by human activities. Diversity involves the variety and variability among living organisms and the ecological complexes in which they occur. NBS believes that only through resource-management policies that promote diversity and sustainability can we meet the resource needs of today and maintain options for future generations.

PRINCIPLE 3

Principle Three is that *Ecosystems are Complex and Dynamic*. Awareness and understanding of the changes in ecosystems is essential to good management. Systems change and evolve over time regardless of human actions, and an understanding of these changes, the how and the why of their occurrence, is essential to good resource management. Employing an ecosystem approach to NBS research, inventory, and monitoring programs will assure consideration of ecological processes and they will be addressed at a variety of geographic scales and different time frames.

Design flexibility in NBS programs will promote understanding of the interconnectedness of ecological components and thereby provide a better grasp of the probability and nature of future changes. A major effort of NBS will be to expand traditional single-species biological research to include both genetic and ecosystem-level activities.

One of the first priorities of the NBS will be to take a look at sensitive ecosystems like the Everglades, where we have found that not even Interior's own bureaus can easily share scientific data among themselves. It has been suggested that the Everglades is a perfect example of the difficulties of managing an ecosystem in today's world. What happens 80 miles upstream of the park boundary is surely more important to the future of the Everglades than the day-to-day decisions made within the park itself. It is our job to pull the disparate research efforts together into a useful science composite on which everyone can rely.

PRINCIPLE 4

NBS clearly recognizes that *Partnerships are an Essential Part of Implementing Ecosystem Management*. From the very first day of its existence, NBS has emphasized strong working relationships with state, federal, academic, and private entities, and we have taken steps to coordinate biological data collection and sharing. We believe that strong partnerships are an essential component of an ecosystem approach in that ecosystems cross ownership boundaries and involve a wide variety of public interests, land managers, users, and resource disciplines. We know that solutions to complex resource issues and reaching the goal of sustainable development and environmental quality require shared responsibility, cooperation, and an emphasis on public participation.

NBS will seek partnerships to assure that ecologically sound information is available to inform resource-management decisions. We are well aware that public interest in environmental issues and resource management is at an all-time high and that only through a collaborative approach to resource problem solving can we address the wide range of issues of importance to our customers. We plan to take full advantage of the wealth of information residing outside of federal institutions and make arrangements for dealing with the ecological, economic, and human-dimension aspects

associated with resource-management issues. As proof of NBS's commitment to being client-conscious, a Policy Board will be established to provide recommendations on overall research directions. Composed of the directors of all the bureaus at Interior, the Policy Board will guarantee that the needs of NBS's primary customers will be met.

PRINCIPLE 5

NBS recognizes that *Integrated Resource Information is Essential to Implement an Ecosystem-Management Approach.* We believe that ecosystem management promotes an integrated approach to resource inventory, data management, and analytical methods. This includes developing ecological classifications which address a wide variety of geographic scales and time periods, and then measuring parts of ecosystems in similar ways so that pieces can be fit together. Scales of interest may range from small watersheds or habitats to larger bioregions, depending on the resource issue at hand. Plans must recognize that small ecosystems fit within and affect larger systems in order to develop information that can effectively guide management decisions.

One of the three program components of NBS is the Office of Information and Technology Services whose mission is to provide access to, disseminate, and share biological data. One of their primary projects in this first year is to create a National Biological Information Infrastructure which will be a federation of distributed databases and serve as a clearinghouse for biological information. Data gathering and analysis systems such as remote sensing and geographic information systems will be fully utilized in this effort. In addition, the NBS Office of Inventory and Monitoring will emphasize the development of data-collection standards, and protocols that will promote data integration and usability.

PRINCIPLE 6

Another principle of importance is that *Desired Ecosystem Conditions Will Guide Management Decisions.* Descriptions of desired future conditions for ecosystems at various geographic scales should integrate ecological, economic, and social considerations into practical statements that can guide management activities. Descriptions should consider physical, biological, social, and economic factors; and strive for balance, equity, and harmony between people and the land. An adaptive-management approach that includes solid science, monitoring, and evaluation is fundamental to our ability to incorporate response to uncertainty in management decisions and actions. We believe that ecosystem management is not an end in itself but a means to achieve a sustainable future with healthy, functioning ecosystems and that adaptive management is fundamental to our ability to incorporate response to uncertainty in management decisions and actions.

PRINCIPLE 7

A final principle, and one that is basic to the mission of the NBS is that, *Good Management Requires Good Science.* Ecosystem management requires strong ties between land managers and research scientists in order to continually improve the scientific basis for management decisions. NBS is committed to work toward a synthesis of current knowledge of ecosystem structure and function and to provide this knowledge to resource managers and decision makers. Monitoring will be indispensable in judging the results of resource-management decisions and for improving techniques and analyses.

Monitoring information will also provide the focus for new research and this research will involve a high degree of interdisciplinary cooperation and a blending of the social, physical, economic, and biological sciences. We believe that a thorough understanding of all of these components, including information about the changing perceptions, needs, and values of human beings is needed for good decision making. Ecosystem management comprises a mighty challenge for the NBS. Our efforts are evolving, building on new knowledge and a better understanding of how natural systems work.

ORGANIZATION OF NBS

I would like now to briefly discuss the organization of the National Biological Survey and describe how, through its primary programs, we plan to meet this challenge and achieve the ideals of our mission. The National Biological Survey became operational on November 11, 1993, when the biological research, inventory, monitoring programs, and personnel from seven Departmental bureaus were consolidated into the new science agency. The NBS mission states that NBS will "... gather, analyze, and disseminate the information necessary for the wise stewardship of our Nation's natural resources, and to foster an understanding of our biological systems and the benefits they provide to society." The benefits envisioned by this realignment were to improve research productivity and quality, reduce competition for resources, provide leadership in the area of biological science and thereby provide the opportunity for more resources, focus Departmental policy issues, and foster greater credibility through good science and a proactive/anticipatory style.

NBS field units are the primary vehicle for implementing NBS programs and projects developed through a planning process, in accordance with Secretarial and Congressional guidance and in consultation with our partners. A major role of the ecoregional staff is to ensure, through continuous communication with counterparts, that needs of DOI resource managers are known and brought to the attention of the Director. Ecoregional directors will have the responsibility for supervision of 13 NBS Science Centers and over 100 field stations. The Cooperative Research Units, although not technically part of the regional organization, provide specialized expertise and offer access to the varied capabilities of cooperating universities.

The NBS field structure will be comprised of four regional offices with appropriate geographic responsibilities. Each regional office will have a small staff with the responsibility, as I have mentioned, of coordinating NBS activities in the research centers and field units, and coordinating biological information needs with the multitude of NBS customers within its geographic area. Location of the re-

gional offices is not yet completely resolved but the likely locations are: Seattle, Washington; Denver, Colorado; LaFayette, Louisiana; and Leetown, West Virginia.

Activities in the Headquarters Office in Washington, D.C. center on an Administration Directorate and three major program areas: Research, Inventory and Monitoring, and Information and Technology Services.

Focus of the Research program will be to provide timely and objective science that applies to priority resource issues of the Department and the nation. The products of research help to assure that difficult issues are resolved optimally, on the basis of sound scientific knowledge.

The mission of the Inventory and Monitoring program is to work with partners, at all levels, to inventory and monitor the nation's biological resources, to determine and evaluate their status and trends, and to report on these to the people of the United States. We will employ a hierarchical approach to our work and we will rely heavily on existing national programs.

The third program is Information and Technology Transfer. The mission of this group is to provide access to, disseminate, and share biological-resource data and information. Please understand, however, that NBS will not seek to create large centralized scientific databases, but will encourage increased access to databases that are maintained and enhanced by those with the most direct interest and knowledge about the subjects. NBS will also not impose a specific solution on regional stake holders, but will attempt to catalyze collaborative efforts.

CONCLUSION

In summary, NBS is in the business of developing the biological knowledge that will allow effective management and, as the Secretary has suggested, keep the regulatory axe from falling. We, in partnership with many others, will develop standardized scientific models and protocols and other tools so that data from many sources will be interchangeable. We are determined to make the NBS user-friendly for resource managers, researchers, and others. It is an exciting time to be at the Department of the Interior and the National Biological Survey. For the first time, we see the biological sciences being given an operational niche similar to that enjoyed by the earth sciences in the U.S. Geological Survey. The National Biological Survey seeks good management through good science and I am confident that with a high level of energy and the support of groups like those represented here today, we can meet the goals we all seek and provide a valuable service to the nation.

Thank you.

State Participation in Ecosystem Management

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Abstract

The Utah Department of Natural Resources initiated a number of programs before the term "ecosystem management" came into vogue that employ principles and concepts characteristic of EM. The Book Cliffs Conservation Initiative is a cooperative, multiple-use undertaking by the State, Bureau of Land Management, Nature Conservancy, Rocky Mountain Elk Foundation, and private landowners. Antelope Island State Park is a cooperative management effort by several state agencies, and Salt Lake and Davis counties, managed by the state Division of Parks and Recreation, and engaging active public participation. The Southwestern Utah Planning Authorities Council is a coordinated effort by representatives of 18 federal, state, tribal, and local government entities to manage the Virgin River basin. It is intended to be an experiment in intergovernmental cooperation in ecosystem management. If it succeeds in the Virgin River basin, we hope to implement it elsewhere in the state. The Escalante Canyon Task Force is an effort by federal, state, and local officials to designate an area of spectacular natural resources as a national conservation area, and reconcile the competing demands of the environmental community and historic land users (grazing, timber, mining, oil and gas).

Five perspectives on ecosystem management: (1) It concentrates on prevention rather than repair through comprehensive cooperation and coordination. (2) The states must take the lead in implementing ecosystem management. (3) It is a process, not an outcome, involving communication and coordination between various levels of government and citizenry. (4) It cannot be "top-down driven," a mechanism of central planning. (5) It cannot be a tool of such "second agendas" as a means of expanding federal power, diminishing property rights, or tolerating bad science.

INTRODUCTION

I want to thank and congratulate Utah State University and Dean Joe Chapman for a highly successful symposium. I began yesterday's session with many more unanswered questions about the subject of ecosystem management than I have today. That tells me that this has been well worth my time, and I hope that you can say the same.

I would like to recount a few of the experiences of the State of Utah in attempting to manage ecosystems and to share with you some miscellaneous thoughts on the subject.

One caveat I would like to insert at the beginning is that a number of the things I will relate were initiated *before* the concept of "ecosystem management" came into vogue. In other words, we were ecosystem managers and we did not even know it!

ECOSYSTEM MANAGEMENT EXAMPLES IN UTAH

BOOK CLIFFS CONSERVATION INITIATIVE

I believe the finest example of ecosystem management in the State is found in the Book Cliffs initiative in east-central Utah. This initiative was cooperatively developed by the Utah Division of Wildlife Resources, the Bureau of Land Management, the Nature Conservancy, and the Rocky Mountain Elk Foundation. Other organizations have been supportive players also.

The Book Cliffs initiative encompasses an area of approximately 455,000 acres. Some 70% (319,000 acres) of the total is administered by the Bureau of Land Management, 25% (114,000 acres) are lands administered by the Utah Division of State Lands and Forestry, and 5% (22,000 acres) are privately owned lands.

The private lands are the key to the initiative. As is usually the case, the bulk of the private lands are located within four ranches in the canyon bottoms, containing streams which flow through the area. The key objective has been to purchase at least three of the four ranches, all three of which have been on the market. Currently, that has largely been accomplished.

Ownership of the ranches will allow for control of grazing on permitted federal lands. Better management of grazing will allow for restoration of riparian areas and enhancement of watersheds which have been adversely impacted in the past.

Public ownership will also restrict the amount of private development that can occur in the area—development which

could be in competition with the primary wildlife values. Finally, public control of the ranches would allow for greater public access to this unique and valuable area of wildlife habitat.

The wildlife species in the area include moose, bison, bighorn sheep, black bear, deer, elk, antelope, mountain lion, waterfowl, shorebirds, blue and sage grouse, golden eagles, numerous hawks, and many small mammals, birds, amphibians, and reptiles. A number of endangered or sensitive species also inhabit the area, including the Mexican spotted owl, peregrine falcon, and Colorado cutthroat trout.

It is the intent of the initiative participants to manage the Book Cliffs as a multiple-use showcase. Management will focus on increased wildlife density and diversity, riparian habitat, enhanced water quality, fisheries expansion, and recreational opportunities. But other uses such as livestock grazing, mineral development, and oil and gas production will continue in an environmentally sensitive fashion.

Cooperative management between the federal and state administrators will be emphasized. A coordinated resource management plan is to be put in place.

This is an excellent example of management of an ecosystem. There have been roadblocks, however. One is the opposition by some to the purchase of private lands by public entities. Another is the fact that the significant number of acres which are School Trust Lands (approximately 1/4 of the total) must be managed for optimization of revenues to the Trust. That block of 114,000 acres of Trust Lands is among the most valuable in the area because it is currently roadless. We are committed to finding a way to obtain those lands for the initiative if at all possible.

ANTELOPE ISLAND STATE PARK

Antelope Island is an island of approximately 26,000 acres in the south end of the Great Salt Lake. The Utah Division of Parks and Recreation is the owner. For a number of years prior to the early 1980s, the island was accessible by a causeway from the northeast. Modest facilities existed on the north 2,000 acres of the island.

In the early 1980s, however, abnormally high precipitation led to a rise in the level of the Great Salt Lake which flooded and destroyed the causeway. It was not reopened until just last year.

Antelope Island is a jewel in the state park system. It is an island which remains largely untouched, even though it is within a veritable stones-throw of Utah's population center. The planning which State Parks has undertaken in order to arrive upon its resource-management plan for the development of Antelope Island State Park is an example of ecosystem management.

As the lake began to recede, and pressure to reopen the island increased, there was a temptation to throw together a plan and let the chips (a technical term here, inasmuch as Antelope Island is home to a large herd of buffalo) fall where they may. The Division chose to follow a much more disciplined path.

State Parks was fortunate in that years of study and research associated with acquisition, condemnation proceedings, and academic curiosity had resulted in an abundance of papers, reports, and studies regarding the island. These resources were used as a baseline for the Division's management process.

The Division further leveraged its limited resources by calling upon a long list of state and local governmental agencies including: Utah Geological Survey, Wildlife Resources, Water Resources, State History, Salt Lake County and Davis County. The creation of long-term relationships with the two mentioned counties which are most impacted by the park was especially important.

Planners made every effort to obtain public input. The public-participation effort included an open house, three public meetings, a questionnaire handed out to visitors to the park once it reopened, and constant outreach to public agencies and officials.

The public involvement also included opportunities for the public to comment on the "near draft" of the plan.

This process was admittedly slow and laborious. That fact led to an effort in this last legislative session by one of the counties most affected by the park to take over its ownership. The county admitted that its planning processes were much less detailed. This points to one of the general negatives of ecosystem management: to those in a hurry, it can be frustratingly slow!

Nonetheless, the care and attention to detail in the Antelope Island Management Resource Plan will pay off to the State Division of Parks and Recreation as it undertakes the process of obtaining support in the legislature for needed funds, and as partnerships with other agencies of government and private entities are established, and finally as the public begins to enjoy the exquisite natural resource that Antelope Island is.

SOUTHWEST UTAH PLANNING AUTHORITIES COUNCIL (SUPAC)

Southwestern Utah is unique among areas of the West. It is the confluence of three very distinct ecosystems—the Great Basin ecosystem, the Colorado Plateau ecosystem, and the Mojave Desert ecosystem. Washington County has become the battleground for almost every public-land and natural-resource issue imaginable, including wild and scenic river protection, endangered and sensitive species, wilderness designation, water development, concerns over groundwater depletion, federal reserved water rights, protection of national park values, etc.

Local governments find themselves under attack. Level upon level of state and federal governments are engaged in planning for the area. Most such planning was conducted in a void, with little real participation by other governmental agencies.

In a meeting with Utah's Governor Leavitt last summer, a number of federal officials, in a moment of real candor, admitted that the Bureau of Land Management, National Park Service, and the Forest Service were going down their respective resource planning paths with little or no communication among themselves, let alone with local and state agencies.

Governor Leavitt suggested, and the federal agencies willingly agreed to participate in, a novel approach to ecosystem management.

Since early last fall, 18 representatives of federal, state, tribal, and local government entities have been meeting in an effort to coordinate planning activities in southwest Utah. The effort is referred to as Southwest Utah Planning Authorities Council (SUPAC). The ecosystem in question is the Virgin River basin. We have signed a Memorandum of Understanding under which we agreed to coordinate our planning activities as closely as possible, avoiding unnecessary duplication where feasible. We have created a technical team which is exploring ways to maximize access to one another's data systems. We have put into place a common planning calendar.

A very concrete success occurred in our last meeting. It was agreed that the three major federal agencies—Forest Service, National Park Service, and Bureau of Land Management—would work together with other members of the committee to integrate analysis of potential wild and scenic river units within the Virgin River basin. This is an issue that has risen to the top in the list of potential hot-spots in recent months, and the agreement to allow input from local and state governments at the earliest possible stage of planning is a signal of the federal agencies' commitment in making this process work.

SUPAC is intended to be an experiment in intergovernmental cooperation and ecosystem management. If it succeeds in the Virgin River basin, we hope to implement it elsewhere in the state.

ESCALANTE CANYON TASK FORCE

The Escalante Canyon area of southern Utah is among the most spectacular backcountry in the world. A national park and a national recreation area border it on the south and the east. A designated Forest Service wilderness area makes up its northern border. On the west lies the Kaiparowits Plateau.

The unique character of the area has made it a fertile plain for resource conflicts. A large portion of the canyon area is sought to be designated for Bureau of Land Management wilderness by the environmental community. On the other hand, those who reside there are concerned about maintaining as much of an economic base as possible. The historical uses include grazing, timber production, mining, and oil and gas production.

A few years ago, the local Bureau of Land Management office joined with the local community to attempt the creation of a national conservation area. The boundaries were not confined to Bureau of Land Management boundaries alone; Forest Service, national park and monument, and State Trust Lands were all considered part of the Escalante Canyon ecosystem and were included in the proposed conservation area. A bill was introduced in Congress to designate the area a national conservation area subject to the conditions agreed upon.

Unfortunately, congressional reapportionment and the emergence of other priorities resulted in the effort falling dormant for two years.

However, there is currently an attempt to resurrect the concept. Federal, state, and local officials are again meeting to formulate an innovative way to protect the Escalante Canyon ecosystem. It is a serious effort to protect the unique national qualities of the canyons, while trying to preserve as many of the historic use patterns as possible.

We are not confining our discussions to the former proposal, nor to existing concepts of land management. What will ultimately come out of the work of the Escalante Canyon task force is yet to be seen, but it is another example of an effort to undertake the management of an ecosystem without the constraints of land ownership or administration.

There are other examples that, if time allowed, I could detail. I am confident that with the knowledge gained over the last few days, we as a state will be even more aware of opportunities to initiate or participate in ecosystem management.

PERSONAL PERSPECTIVES

For the remainder of my allotted time, I would like to give you some personal perspectives on this subject. These do not follow any particular order or pattern so please bear with me.

ECOSYSTEM MANAGEMENT IS THE "FENCE," IN CONTRAST TO THE "AMBULANCE"

Let me provide a slight change of pace if I may. I would like to share with you portions of a poem by Joseph Malins entitled "A Fence or an Ambulance." I hope that its relevance to the subject at hand will be clear to you.

Twas a dangerous cliff, as they freely confessed,
though to walk near its crest was so pleasant;
but over its terrible edge there had slipped
a duke and full many a peasant.
So the people said something would have to be done,
but their projects did not at all tally;
some said, "Put a fence around the edge of the cliff,"
some, "An ambulance down in the valley."

But the cry for the ambulance carried the day,
for it spread through the neighboring city;
a fence may be useful or not, it is true,
but each heart became brimful of pity
for those who slipped over that dangerous cliff;
and the dwellers in highway and alley
gave pounds or pence, not to put up a fence,
but an ambulance down in the valley.

"For the cliff is all right, if you're careful," they said,
"and, if folks even slip and are dropping,
it isn't the slipping that hurts them so much,
as the shock down below when they're stopping."
So day after day, as these mishaps occurred,
quick forth would these rescuers sally
to pick up the victims who fell off the cliff,
with their ambulance down in the valley.

Then an old sage remarked: "It's a marvel to me
that people give far more attention
to repairing results than to stopping the cause,
when they'd much better aim at prevention.
Let us stop at its source all this mischief," cried he,
"come, neighbors and friends, let us rally;
if the cliff we will fence we might almost dispense
with the ambulance down in the valley."

"Oh, he's a fanatic," the others rejoined,
"dispense with the ambulance? Never!
He'd dispense with all charities, too, if he could;
No! No! We'll support them forever.
Aren't we picking up folks just as fast as they fall?
And shall this man dictate to us? Shall he?
Why should people of sense stop to put up a fence,
while the ambulance works in the valley?"

But a sensible few, who are practical too,
will not bear with such nonsense much longer;
they believe that prevention is better than cure,
and their party will soon be the stronger.
Encourage them then, with your purse, voice, and pen,
and while other philanthropists dally,
they will scorn all pretense and put up a stout fence
on the cliff that hangs over the valley.

It occurs to me that for too many years, management of our valuable natural resources has consisted of running ambulances in the valley below. We have concentrated our efforts at repair, when prevention would have been more effective. Perhaps the clearest example is that we have waited until a species is near extinction, and then we try to protect it.

Another example is the vitriol and conflict that results when those with different agendas fail to cooperate and coordinate or even discuss, until we hit the symbolic ground below.

We have allowed ourselves to be hog-tied with ownership or land administration constraints, when we should have broken free for management purposes. We have undertaken our respective planning efforts in self-serving vacuums—with little effort to coordinate with our state, federal, or local counterparts.

Preventing resources abuse through comprehensive cooperation and coordination is far superior stewardship management to the historical isolated piecemeal approach.

This symposium has been intended to help us devise methods to construct the symbolic fence.

WHO SHOULD TAKE THE LEAD IN ECOSYSTEM MANAGEMENT?

In a public land state such as Utah, ecosystem management faces unique challenges. A look at an ownership map of the State, with its scattered School Trust sections, intermingled private ownership, large federal holdings that are divided among the Bureau of Land Management, Forest Service, National Park Service, and Department of Defense (along with several other, miscellaneous federal administrators), topped off with significant amounts of Native American lands, reveals that ecosystems and land administration bear no relationship.

Despite the large amount of land in the state of Utah owned by the federal government (approximately 70 percent), no single federal agency has jurisdiction over the entire land base of any *significant* ecosystem.

Even within those ecosystems where the land may be owned or managed exclusively by the federal government, the federal government does not have jurisdiction over important elements of the ecosystem. For example, the Forest Service (or Bureau of Land Management, etc.) may own the land, but the State has management of the wildlife, and the water is under the jurisdiction of the State.

Political or jurisdictional boundaries do not match any ecosystem.

Even though ecosystems do not conform to State boundaries either, perhaps states are the most practical unit where the line for management purposes should be drawn. Even though states may be a minority landowner, they do maintain *statewide* jurisdiction over wildlife, water, regulation of water, air quality, etc. For these reasons, I believe it is incumbent upon states to take the lead in implementing ecosystem management.

ECOSYSTEM MANAGEMENT IS NOT AN OUTCOME, IT IS A PROCESS

I do not see ecosystem management as the end result. I believe that it is a process, a method of management. I define it as communication and coordination between various levels of government and citizenry. It is based upon a sharing of the very best data and information and a balancing of needs and values so that better decisions can be made. It is "situational," i.e., the geographical scope of an ecosystem will vary with the circumstances; the available data and information, the governmental entities involved, the geography, the resource of greatest concern, etc. Therefore, it is not important (or possible), for us to all leave here today with a fixed understanding of what an "ecosystem" is in all circumstances, but it is essential that we accept the imperative that we work together in the challenge of resource management.

ECOSYSTEM MANAGEMENT CANNOT SUCCEED IF IT IS TOP DOWN DRIVEN

Those of us who see ecosystem management as a positive thing must be careful to avoid trying to shove it down the throats of others. I believe we are doomed to failure if we at the state or federal level see it as a mechanism of "central planning." We must involve local governments and citizens every step of the way. Their active involvement and acceptance is critical to success.

ECOSYSTEM MANAGEMENT CANNOT BECOME THE VICTIM OF "SECOND AGENDAS"

I cannot think of anything that would be more counterproductive to the acceptance and successful implementation of ecosystem management than for it to become a tool of those who have so-called "second agendas." Specifically, it cannot be used to expand federal power vis-a-vis the states or local units of government. Second, it cannot be used to diminish private property rights. And third, it cannot become a cover for bad or inadequate science.

It will also fail, in my opinion, if the ecosystem proposed for management is defined as pre-Columbian in nature, i.e., pre-European settlement.

CONCLUSION

The state of Utah is committed to become a leader in the area of ecosystem management. Personally, I see it as a major opportunity for those of us who have stewardship over natural resources to do our jobs better with less conflict and greater rewards.

Thank you.

BLM's Ecosystem Approach to Management

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Abstract

Ecosystem management is about maintaining the health, diversity, and productivity of the land, i.e., clean water, abundant native perennial grasses, sustainable fish populations, healthy watersheds. We will use the ecosystem approach to streamline administrative processes and improve fiscal and environmental accountability. It involves coordinated planning at the local level, forming partnerships, and using good information to manage the land. Education is key. The principles of ecosystem management form the philosophic underpinning of a new land ethic with roots in the philosophies of Roosevelt, Pinchot, Leopold, and others.

INTRODUCTION

My crusade in the BLM is to get a bureaucracy back to basics, to cut process and keep things simple. The ecosystem approach is often greeted with skepticism, outright distrust, or confusion. People don't trust things we don't understand. Ecosystem management is a good case in point.

What we have to do is not complicated. It's not mystical. It's plain common sense. It's doing what's good for the land. One of the greatest challenges facing land-management agencies today is achieving and keeping a clear focus and vision of where we want to go from here.

I'd like to take this opportunity to discuss four issues related to ecosystem management with you today. First, I'll talk about what it is. Second, how the concept evolved. Third, how it will translate to on-the-ground decision-making. Fourth, and most important, what you, our customers, can expect from the public lands under an ecosystem approach.

We need to work very closely with people. To me ecosystem management means healthy, functioning watersheds or landscapes that provide social and economic stability to local communities.

ECOSYSTEM MANAGEMENT: WHAT IS IT?

We tend to be our own worst enemy by making definitions of ecosystem management more complicated than they need to be. But when you cut through the verbiage and fodder, there is nothing mysterious or uncertain about it.

Put ten biologists, ranchers, and conservationists in a room and they'll come up with ten different definitions. It's not the definitions or lines on a map that are important. What matters is how we treat the land.

I always like to start discussions from common points of agreement. And I guarantee you when the smoke clears from that room of biologists, ranchers, and conservationists, they'd all agree on at least one point: We have to maintain the health and productivity of the land. That's what ecosystem management is really about—maintaining the health, diversity, and productivity of the land. If we can all agree on that, and I think we do, the ecosystem approach provides common ground from which to develop consensus-based decision-making.

"Protecting ecological sustainability," "conserving biological diversity," and "preserving ecologic integrity" are all fancy ways of talking about lands with clean water, an abundance of perennial native grasses, sustainable populations of extraordinary fish like salmon, and healthy watersheds. All Americans recognize the value of these things.

A century ago, Theodore Roosevelt put it nicely when he said:

> If we of this generation destroy the resources from which our children would otherwise derive their livelihood, we reduce the capacity of our land to support a population, and so either degrade the standard of living or deprive the coming generations of their right to life on this continent.

And that's what it's all about, isn't it? Maintaining healthy, diverse, and productive watersheds so that present and future generations may continue to derive benefits from the land. Simply said, ecosystem management is the application of common sense to common problems for the common good.

ON-THE-GROUND DECISION-MAKING

Here we stand today, two years shy of the BLM's 50th anniversary, rapidly approaching the year 2000. The West has changed dramatically since the early days of the General Land Office. In the 19th century, we thought we had limitless supplies of fish and wildlife, wood fiber, forage, and minerals. Historical land use policies helped to settle and develop a growing country.

No frontiers remain in the American West. And development has not come without cost to the health and sustainability of the land. We may never know the true extent of incremental and cumulative changes to the landscape. But their effects are real and visible.

Today the West faces the explosive spread of noxious weeds, threatened, endangered, and extinct species, stream courses and rangelands in need of repair, impaired water quality, and fundamental changes in the way we view and administer the land. But we are not starting from ground zero. I believe the catalyst of change is ecosystem management. To me there are nine operating principles to guide implementation of the ecosystem approach. They are:

Sustain the productivity and diversity of ecological systems. Or simply put, keep the land healthy. Know the condition of the land. Communicate with and involve all interested publics. Have common goals. Fix what's wrong. Use and have available information and the best science. Base planning and management on long-term horizons and goals. Or, think ahead. Reconnect isolated parts of the landscape. Or, look at the big picture. Practice adaptive management. That is, be flexible.

Albert Einstein once noted that "the significant problems we face today cannot be solved at the same level of thinking we were at when we created them." I think that's the right attitude from which to approach our task.

Our laws direct us to manage natural resources without impairing the long-term health of the land. I think we all agree that's an appropriate goal. Is our approach to land management based on yesterday's demands of a society whose values and needs have changed? We now know that overemphasizing commodity production, commercial use, and intensive development can compromise, and ultimately jeopardize, the land's health.

The agencies have created excessive and often conflicting policies, rules, and regulations. We will use the ecosystem approach to streamline administrative processes and improve fiscal and environmental accountability. I envision a BLM that can effectively serve our customers while efficiently accounting for taxpayer money spent. We will measure our effectiveness by the condition and health of the land. It is high time that the Bureau begins to uncomplicate our bureaucratic process. I believe what we need to do is not complicated or abstract. It's straight-forward common sense.

WHAT THE PUBLIC CAN EXPECT FROM THE PUBLIC LANDS

Charles Wilkinson believes that "it should not be so hard to mesh the needs of the lands and waters and the people. They ought to be the same."

We must always consider the health of the land. How much forage is available to wildlife or cows from rangelands infested by leafy spurge or cheatgrass? What good to a community is a watershed contaminated by runoff from an abandoned mine? Or a fishery ruined by excessive sedimentation from erosion?

We must respect the limits of the land. We must acknowledge that we don't know everything and be adaptable to new information and changing circumstances. An ecosystem approach will not eliminate the need to make difficult decisions to accomplish social and economic goals. We must have the information to make these decisions—and know they are not likely to impair the health of the land.

Here's what we should expect: Clear, cool streams filled with fish. Stable soils that help prevent erosion. Riparian areas that keep streams clean and provide habitat for wildlife and birds. A healthy mix of native grasses and heavier calves. In short, productive, diverse, and healthy lands that maintain sustainable levels of forest products, minerals' development, forage use, and provide a wide variety of educational and recreational opportunities. Education is key.

Simply put, ecosystem management is a way of doing business. It involves coordinated planning at the local level, forming partnerships, and using good information to manage the land.

We must lead by example. We must sit down with other federal, state, and interested private land owners to develop a consensus vision for the land. A vision based on maintaining healthy watersheds and diverse and productive ecosystems. I'm asking for your help. We need the active participation of stakeholders and other interested parties.

If we do our job right, local communities will be in the lead. People will recognize and appreciate the social and economic benefits of maintaining healthy and diverse ecological systems.

We must know the condition of our lands, and work together to achieve their health.

CONCLUSION

The principles of ecosystem management form the philosophic underpinning of a new land ethic. An ethic with roots in the philosophies of Roosevelt, Pinchot, Aldo Leopold, and many others. An ethic designed to maintain ecosystem health so that future generations may continue to enjoy benefits from the land. Remember the old proverb: "We have not inherited the world from our forefathers—we have borrowed it from our children."

Thanks for being here today. I'd be happy to answer any questions.

HORIZONTAL SYNTHESES OF SPEAKERS' COMMENTS ON THE FOUR THEMES

THEME 1

WHAT IS ECOSYSTEM MANAGEMENT?

THEME 2

WHAT ARE THE TECHNICAL, NATURAL-SCIENTIFIC PROBLEMS OF IMPLEMENTING ECOSYSTEM MANAGEMENT ON THE GROUND?

THEME 3

WHAT SOCIAL AND POLITICAL MECHANISMS WILL BRING DISPARATE GROUPS TOGETHER IN AGREEMENT ON MANAGEMENT GOALS?

THEME 4

WHAT ARE THE LEGAL AND ADMINISTRATIVE PROBLEMS SURROUNDING THE ISSUES OF MULTIPLE LAND OWNERSHIP, FEDERAL, STATE, AND PRIVATE?

What Is It That Is Being Referred to As Ecosystem Management?

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Abstract

The wide range of definitions of ecosystem management depend upon the values of the persons defining it. While many of the speakers did not provide an explicit definition, four themes common to their presentations were ecological, social, political, and economical. We distilled from these presentations the following: ecosystem management is the manipulation of an ecosystem with all its species and functions to achieve specified social goals, and policed by the political system for some specified, sustainable economic return. A major source of contention is whose values should prevail. Since societal values change over time, EM must be flexible. Ecologically clear-cut boundaries do not necessarily provide socially and politically optimum results.

The general consensus currently being voiced by the public and natural-resources managers is that the techniques of land and species management used to date have not been meeting the needs of the public or the natural resources. A shift in ideology to embrace a new method referred to as ecosystem management is being advocated. The move by land-management agencies and the scientific community to convert to ecosystem management includes consideration for differing social values, adjustable spatial scale, and a heavy reliance upon scientific methodology. The prevailing attitude throughout the natural-resources field is that ecosystem management is a better strategy for accommodating demands upon the environment. However, there is a wide range of definitions applied to the term "ecosystem management" which depend upon the values of the persons defining it. With so many definitions for ecosystem management, what exactly is it to which people are referring? This symposium and similar meetings have been designed to illuminate the issues of ecosystem management and come to a greater consensus on definitions and policies. Our group's task has been to differentiate how well the orators addressed the definition of ecosystem management.

We thought that the majority of speakers tended to avoid giving an exact definition of ecosystem management. Rather, we found that their definitions could be inferred from their description of how ecosystem management should be achieved. As we synthesized the common aspects of each individual's presentation, we found four common themes associated with the term. These themes are: ecological, social, political, and economical. Although each speaker may not have addressed each of the four themes specifically, most did in some manner.

The ecological theme collectively refers to the earth's natural environment without human influence. Ecosystems are presumed to manage themselves with or without human influence. Considerations for human influence are subsumed in the social theme and consist of both human effects on the environment and societal values. The social aspect is the driving force behind ecosystem management because it is societal values that drive human actions which modify the environment and determine the desired outcomes of the management approach. Economics measures the value of what society expects to derive from the environment and may be classified as a subcategory of the social aspect. The economic theme includes both monetary and aesthetic values. The political mechanism regulates the social demands upon the environment by enacting laws, and enforcing them through the judicial system.

The speakers did not agree on which theme or themes were the most important, but they did agree that all impinged upon the management of resources. Any procedure for managing an ecosystem must therefore consider each of the themes in order to be effective. How large a role each theme is allotted will depend upon the background of the local administrator and the management goal. The management goal depends upon social values and economic importance.

Agreeing upon a concrete definition of ecosystem management is as difficult as finding a common set of goals and

objectives in an ecosystem-management plan due to contrasting societal values. Chris Risbrudt opined that ecosystem management will never be explicitly defined or universally accepted. Dave Roberts added to this insight by stating that there are multiple definitions, each one varying in emphasis. It is crucial to identify the emphasis and work for a consensus rather than argue over a definition. Roberts equated the definition of ecosystem management to a cookbook: just like a cookbook, a definition is nice, but one cannot eat it. We need a cookbook when we have limited cooking knowledge, but after we become comfortable at cooking, we can 'wing it' and the cookbook is no longer necessary. He was implying that a set of parameters is needed to implement ecosystem management in the beginning, but will become less necessary as the level of knowledge increases.

In formulating a group definition of ecosystem management, we collectively used the speakers' descriptions of methodology. From analyzing the context of the speakers' talks, we define ecosystem management as manipulation of an ecosystem with all its species and functions to achieve specified social goals, and policed by the political system for some specified economic return. The ecological component is independent of the other themes. The ecosystem does not need humans to manage it in their absence. However, when humans enter the picture, the process becomes anthropocentric.

What is considered good ecology is in the eyes of the observer. Different value-driven uses of the land have different ecological effects. Therefore, humans not only determine the social, political, and economic factors of ecosystem management, but in doing so they also determine the ecological ones. Social values dictate what objectives are set for ecosystem management. Then, political entities are needed to regulate and enforce the use of the environment. All of this human activity centers around the ecological motivation of managing limited resources, and at the same time trying to provide economic return. Once again, what is considered satisfactory economics depends on the underlying social values.

The speakers addressed certain issues associated with ecosystem management from their perspective. These issues were ecological by nature, but implicitly anthropocentric. Whose values should be used tends to be a problem. This constitutes the largest challenge to those involved with ecosystem management. Louisa Wilcox pointed out that the idea of ecosystem management in the abstract is mostly noncontroversial since its importance is evident. However, what the goals and policies of ecosystem management should be in actual situations is hotly contested. While Louisa was advocating a large, protected ecosystem in the Yellowstone area, Doc and Connie Hatfield were stressing sustainable utilitarianism for Oregon ranchers. While both were agreeing that ecosystem management is important, the means to achieve the desired ends differed considerably.

More important than defining ecosystem management is implementing it. Much of the conference was devoted to discussion on how to reconcile the differing public demands placed on ecosystems. Risbrudt commented that government policies associated with natural-resources management (NEPA, ESA) have created a "polarized public." There are those who want full utilization and those who want full preservation. Part of this problem is associated with the fact that private land owners do not like the government telling them what to do with their land. What is really needed is compromise.

Steve Daniels introduced a process of compromise known as "collaborative learning" which helps advocates of opposing viewpoints come to a decision that all find acceptable. He stated that the paradox of ecosystem management is the fact that it should be based on the best science which at the same time may not be understood by the lay public. In other words, the management plan needs to be based on what the ecologists feel would be the best science but this poses a real challenge for the communication that Louisa Wilcox stresses the importance of.

Among the items of controversy, scale is one of the primary concerns. Part of the difficulty in implementing ecosystem management is trying to define the system to be managed. Ecologically clear-cut boundaries do not necessarily provide socially and politically optimal results.

Dave Roberts said that ecosystems have their own spatial and temporal scales, and should be managed as processes rather than areas. The practical application of this is difficult. If the scale is made too large, it can damp out local variability. If the scale is made too small, it can lose context. Some of the selected scales in delimiting ecosystems have been watershed boundaries, largest mammal (indicator species) home ranges, and political delineations. All of these have proven unsatisfactory in addressing all of an ecosystem's functions. In fact, since ecosystems are multiple-scaled, any set scale will have limitations. However, the general consensus in the symposium was that there is a need to utilize larger areas and scales than have previously been used.

Chris Risbrudt commented on a need to look at larger scales 90% of the time. In this country, policy is often made by the courts. George Coggins pointed out that if we are going to be successful in managing at larger scales, it will be necessary to work against the judicial tendency of legal fragmentation.

Another issue affecting the definition of ecosystem management is that of sustainability. Most speakers stated that sustainability over time is the primary objective of ecosystem management. The first problem with this concept is defining it. It can be used as a goal anywhere in the management spectrum between utilization and preservation. So, once again, this concept is governed by the underlying social values attached to an ecosystem. Jack Stanford said that the goal should be ecosystem conservation rather than sustainability because ecosystems are dynamic, and not static. The goal of sustainability may not be realistic when taking global-change factors into consideration. The influence of humans in global change will never be fully understood because there is no way of knowing how the earth would have changed without man's influence. In order to be successful in ecosystem management, we need to concentrate on placing the ecosystem on the right trajectory rather than trying to control it completely.

If human values dictate what will constitute ecosystem management, the goals of ecosystem management will change as human values change. The important aspect of this is recognizing that it will happen, and being prepared for it. A

number of speakers in the symposium stressed the importance of being flexible enough to allow change in management programs. Steve Daniels stated that ecosystem management must be adaptive to future conditions. Adaptability is essential because changes in management objectives are bound to occur. Cooperation among involved parties will be just as important in the future as it is now. Also, ecosystem management must be able to survive the governmental, administrative, and policy changes that are certain to come in the future. Ecosystem management needs to be flexible if it is to become the management force of the 21st century, rather than another 20th-century buzzword.

In conclusion, ecosystem management will be an important resource-management approach in the future. While everyone agrees that ecosystem management is a good thing, there are many different definitions of it. This symposium was held to help clarify some of the important underlying issues involved with ecosystem management. During the symposium, no definite, clear-cut definition was given. Therefore, we used the contextual information to break down ecosystem management into four entities: ecological, social, political, and economic. Ecosystems can exist apart from humans. However, the other entities are determined by humans and their underlying social values. We noted and discussed certain controversial issues surrounding ecosystem management. It became evident that ecosystem management needs to be flexible enough to survive the winds of change if it truly fulfills its destiny in the future.

The Role of Science in Ecosystem Management

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Abstract

Roberts argues that in order to implement ecosystem management, resource management must switch its ecological perspective from an individual- and population-based focus to ecosystem- and landscape-based ecology; from an "object" (form) to "context" (function) approach; and adopt a multi-scalar modelling approach. A major role for science in EM is to predict ecosystem behavior under alternative management strategies. Wilcox, Risbrudt, Thomas, and Kessler all emphasized the critical role of a higher level of science, although Daniels pointed out that there is a risk of creating a politics of expertise. Thus participating scientists have a strong responsibility to communicate their knowledge to the public in understandable ways.

Clearly ecosystem science has an important role to play in the development and implementation of ecosystem management in the Intermountain West. However, because ecosystem management includes a diverse array of players with differing perspectives, exactly what role science will play varies with those perspectives. This paper examines the role of science in ecosystem management as portrayed by the speakers.

At one end of the spectrum, some speakers argued that science should provide the most basic foundation for ecosystem management.

Ecosystem management, as portrayed by the ecosystem ecologist Dave Roberts, was described almost entirely in terms of ecological science. Roberts advocated ecosystem management as an ecological procedure: managing ecological components and processes to achieve and sustain ecological systems while maintaining protection for human use. Roberts' general definition of ecosystem management is different from others at the conference in that it emphasizes ecological science above social and political factors. He does not maintain this is how the paradigm will be implemented, but simply argues what ecosystem management would entail from a purely scientific point of view.

Roberts contends that ecology has long been involved in resource management, but that EM requires a change in the branches of ecological science playing a role. He maintains that the key difference from an ecological perspective between traditional management and EM is the shift from population- and individual-based ecological work, which traditionally dominated forest-management decisions, to ecosystem- and landscape-based ecology. The individual and population approaches were used to maximize production, but landscape, ecosystem, and conservation ecology are all crucial for implementation of EM.

Roberts showed that there have been two main perspectives in the study of ecosystems which have led to confusion when not clearly distinguished. These perspectives are object and context approaches to studying ecosystems. Large differences in management strategies can result, not from large differences in objectives, but simply from differences in how an ecosystem is viewed. The object view considers ecosystems as mappable areas which can be defined. This has been the traditional approach taken by land managers as ecosystems are first mapped, and then management strategies are implemented to achieve desired future conditions. In contrast, the context view considers ecosystems as the combination of all ecological processes taking place, with each process having its own temporal and spatial scale. Thus there are no readily apparent ecosystem bounds since processes take place on a variety of scales. In addition, ecological processes are what are managed, not the ecosystem itself.

Although Roberts argued that ecology has a large role to play in ecosystem management, the role of ecological science has a different focus than it traditionally has had. He believes that ecological science should design management systems which don't emphasize any particular thing to manage for, but instead emphasize the *range* of potential conditions that can be

managed. In addition, science should predict what the future behavior of systems will be in response to management strategies.

Roberts argued that a multiscalar approach can help in the implementation of ecosystem management by examining each organism or process at the correct scale, and interlacing models to get a dynamic picture of ecosystem changes. This approach to ecosystem management also requires new mapping procedures. GIS and the associated algorithms are the future for ecosystem management. Although ecosystem management definitions are vague, the key scientific focus in ecosystem management should be on maintaining and sustaining ecosystems.

The modeling approach advocated by Roberts is a scientifically sound procedure. However, it requires large amounts of information which are not currently available in most cases. This approach assumes that we have the data to make the decisions. Some ecologists, however, advocate an alternative scientific approach which is formulated on the basis that nature is too complex and our understanding of ecosystems is incomplete. Since decisions must continually be made by resource managers, some ecologists such as Winifred Kessler argue that adaptive management is a procedure for making decisions while still advancing our ecological understandings of ecosystems.

Louisa Wilcox, representing the Greater Yellowstone Coalition, also made a strong case for the importance of science. She defined ecosystem management as "that which maintains the integrity of ecosystems, their energy flow, trophic structure, biodiversity of species, and material cycles as well." This definition clearly suggests a vision of ecosystem management based almost entirely on ecosystem science, where social and economic concerns are of secondary importance. Under this vision, ecosystem science and conservation biology provide both the blueprint for future landscapes and the means for achieving that landscape.

For the majority of symposium speakers, and especially those representing federal agencies, ecosystem management meant integrating ecosystem science with sociology and economics. Chris Risbrudt may have most clearly communicated the integrated viewpoint. He provided the Forest Service's four guiding principles of ecosystem management: (1) ecosystem management is an ecological approach to the management of national forests and grasslands, (2) the best scientific information available will be used for decision making, (3) agency partnerships are essential, and (4) public participation should occur at all levels. This definition suggests that community needs will be recognized by drawing products from the land, but that science will play a large part in determining how these products are drawn. Under Multiple Use Sustained Yield (MUSY) management, impacts have typically been assessed at small spatial and temporal scales, often resulting in unpredicted cumulative, landscape-level changes that have disrupted ecosystem function. Under ecosystem management, the principal function of the ecosystem-science disciplines, especially landscape ecology and conservation biology, will be to maintain ecosystem integrity, as well as the natural range of variability and diversity. In this view, understanding the dynamics of natural ecosystem variation, and how this can be integrated with resource management, are the greatest challenges facing ecosystem science.

Jack Ward Thomas recognized that the ideals behind ecosystem management have been around since Leopold's *Land Ethic*, but until now the technology of ecosystem science was incapable of making these ideals feasible. Dave Roberts provided an excellent example of how these new ecosystem-science disciplines might contribute to Thomas's vision of ecosystem management. Thomas also suggested that ecosystem management will force the evolution of a new specialty that synthesizes scientific information for decision makers.

Winifred Kessler indicated that the complex issues generated by ecosystem management will force both managers and the public to develop a new perspective on how resources are managed. Kessler argued that the only way to successfully manage landscapes which are prone to unpredictable changes is through adaptive management, or "learning by doing." Consequently, under her view, science can contribute to management in two ways: through providing information about the ecosystem and through conveying understanding of the scientific method and experimental learning to resource managers.

For many symposium participants, the role of science in ecosystem management is primarily educational. For these speakers, politics and economics are the primary drivers of resource management. Consequently, the principle role of science is to educate managers and the general public, so that the most ecologically sensible resource-management decisions will be made. Steven Daniels contended that applying the best science created a politics of expertise, which provided social legitimacy for ecosystem management. However Daniels also warned that the politics of expertise could lead to exclusion of the people affected by management. To solve this paradox, he maintained that scientists must communicate their knowledge to the public, preferably through a collaborative-learning process. Jack Stanford provided an example of how science can be conducted to provide information for making decisions, and Brett KenCairn and Doc and Connie Hatfield provided examples of how scientists should interact with the public for optimal planning.

For some symposium participants, however, ecosystem science may in fact be irrelevant to the success or failure of ecosystem management. George Coggins clearly indicated that the biggest challenges to ecosystem management will be in the courtroom, not in the laboratory. Because ecosystems cross cultural and political boundaries, Coggins argued that a legal mandate will be absolutely essential if ecosystem management is to succeed.

Clearly, ecosystem science will have many roles to play under ecosystem management. Ecosystem science will help determine how and what resources can be drawn from the landscape. Ecosystem scientists can also provide information to the public so that ecologically appropriate decisions are made. While political science and economics may shape ecosystem management as a policy, ecosystem science will in the end determine whether this new paradigm is the most appropriate way to manage the land.

Social and Political Mechanisms for Establishing Ecosystem Management Objectives

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Abstract

While social values guide the objectives of ecosystem management, successful execution requires a public well-informed on the consequences of alternative decision options. Daniels advocates a group-learning process entitled "collaborative learning" to achieve this understanding. Agency personnel should assume the roles of educators, facilitators, and managers. The agencies must also open up, mediate, and share decision-making power with the public while avoiding advocacy of any particular interest-group's desires. Policy makers have a role in influencing social values by fostering a nonadversarial politics of cooperation and consensus building.

INTRODUCTION

According to Steve Daniels, the paradox of ecosystem management is involving the lay public in an extremely complex, scientific process. Society is made up of the public at large as well as the groups actively seeking change. Succeeding in ecosystem management depends on cooperation between agency employees and scientists working together to inform the nontechnical public, and between the interest groups working together in a spirit of compromise.

Necessary changes can be hampered by organizations interested in maintaining the status quo, erosion of community integrity, ecological illiteracy, the adversarial political system, and resistance to streamlining by agencies. Numerous speakers showed that these things can be overcome to achieve what KenCairn called ecosystem stewardship.

SOCIETY

The social values of the general public should guide the objectives of ecosystem management. However, in order for this to occur, society must be well informed (Grumbine 1994) so that it can evaluate the potential repercussions of its desired uses of an area, and in order that it can view itself as part of the decision-making system.

Daniels addressed this issue by recommending "collaborative learning" as a mechanism that brings people from a certain locale together to share and learn about the challenges facing them in managing their ecosystem. Understanding the various points of view that different members of society hold as well as the potential effects of each's uses of the ecosystem helps bring about a consensus, or at least an increased awareness of the pros and cons of specific management options.

The type of group learning proposed by Daniels, which should include local scientists and managers as well, helps to reshape and mold values which maximize both the health of the ecosystem and the benefits derived from its use. In his view, this is critical because technical information about the management of an area is often supplied indirectly to the public. In such cases, the technical information reaching them bears little resemblance to the actual conclusions drawn from a particular research project because the information is taken out of context or is simply misinterpreted. This breakdown of communication is a weak link that needs to be

strengthened if the public is expected to modify its values and make ecologically sound choices.

Increased awareness and improved discourse can bring persons with differing points of view together. Doc and Connie Hatfield did this with ranchers, the Isaac Walton League, and the U. S. Fish and Wildlife Service on the Trout Creek Mountain project in Oregon. Their project brought these groups together to save an endangered fish.

On a larger scale, KenCairn explained that in forming the Applegate Partnership in Oregon, all of the groups were concerned with forest health, even if they were adversaries. His group actively involved local communities and federal agencies in management of an ecosystem.

SCIENTISTS

Winnie Kessler suggested that there are three things we must ask ourselves as we set ecosystem-management policy. Is the policy economically feasible, is it socially desirable, and is it ecologically sound? Naturally, it should be the scientists' role to decide what ecological soundness is. But they should not isolate themselves from the responsibility of working within the realms of economic feasibility and social desirability as well. It is their responsibility to provide information necessary for effective planning by agencies and policy makers, and for educating the public. David Roberts suggested that the role of scientists is to determine not what should be, but what can be managed.

Just as Kessler's three questions are related, so should natural-resources scientists, economists, and sociologists interact. This calls for the active participation of the scientific community in the ecosystem-management decision process. As the roles of natural-resource managers and other policy makers evolve, so should the scientists' roles change.

Grumbine (1994) suggests that there is a need to adopt "standard definitions, measures and procedures" for dealing with ecosystem management. Kessler called for new approaches for dealing with the complexity of ecosystems. According to her, these new approaches should include study of an ecosystem's range of variability and an attempt to learn to play by nature's rules. It has been said that "ecologists all too frequently forget about people" (Shannon 1991). Daniels recommended that there should be an increase in discourse between scientists and the public.

Kessler contended that science should educate the public, especially on the theme that natural events are natural. There is often a tendency among the lay public, when discussing preservation, to advocate the maintenance of particular sites in their present conditions. This implies a need to manipulate natural processes by keeping perturbations out of ecosystems.

Speaking on the question of what is ecologically sound, Chris Risbrudt mentioned that fire needs to be reintroduced into many ecosystems to maintain their health, but the public rarely sees this as a necessary natural process. They react negatively to the destruction of familiar and symbolic sites and question the wisdom of professionals who are supposed to protect the natural resources of the public domain. Feedback from monitoring can be used as a tool to help educate the public about the nature of ecosystems, as Kessler suggested. Salwasser proposed that science provides information about choices, and influences those choices.

Jack Stanford suggested that scientists keep the question of whether the public understands the research, and the consequences of their decisions, in mind when they are presenting scientific findings.

AGENCIES

If ecosystem management is to become a reality, government agencies must fulfill three roles: educators, facilitators, and managers. To educate successfully the agencies must first understand the ecosystem functions, processes, and thresholds necessary for maintaining ecological integrity and diversity. As educators, the agencies must provide the latest, most accurate technical information to the public. Some training may need to be provided to the public in order to ensure a common basic level of understanding. This is necessary so that the politics of both inclusion and expertise, discussed by Daniels, may be blended to resolve the inherent conflict. If ecosystem management is to truly shift goals from sustained yields to sustained systems, as stated by Kessler, then the thresholds of the system must clearly be explained to all involved parties.

As facilitators of ecosystem management, the agencies must open up, mediate, and share the power of decision making with the public. While they must avoid advocacy of any particular group's interests, they cannot abandon responsibility for the goal of sustaining ecological integrity. Public expectations of immediately resolving natural-resource conflicts through ecosystem management should be tempered. Daniels integrated these and other objectives in what he described as "collaborative learning." While a local, on-the-ground focus involving affected and concerned interests is necessary for ecosystem management to succeed, the agencies must also fulfill their responsibilities under federal environmental legislation and ensure that adequate attention is paid to regional and national concerns about public lands.

While the agencies focus energy on their changing responsibilities as educators and facilitators, their role as managers will also change under ecosystem management. Kessler described the process the agencies need to follow as "adaptive management." This process emphasizes that implementation of ecosystem management is experimental, and requires monitoring, assessment, and modification of objectives if necessary. Because of the complexity and uncertainty of ecosystem management, Kessler also said it should be a learning as well as a planning process.

Agency culture must change in order for ecosystem management to succeed. Direction within the agencies from the top down must stress interagency efforts. Doc Hatfield commented that the duration of job assignment for on-the-ground personnel must be long enough to allow them to truly understand the ecosystem, its management needs, and the concerns of local people. This will allow the local emphasis on ecosystem management to be more effective.

POLICY MAKERS

Those who legislate and execute policy, whether at the community, state, national, or global level, exist in an interdependent relationship with the society in which they govern. Thus, they influence the direction of social attitudes while reacting to their constituents' current social values and expectations. A conflict between the perceived well being of one group with the perceived well being of another requires that policy makers play the role of mediator in conflict resolution. The populace generally accepts the loss of personal liberties if they understand that policies are based on the principles of equity and justice (Adler 1981). During the Ecosystem Management Symposium two approaches to conflict resolution by policy makers were discussed.

The first approach focused on the ability of policy makers to influence social values. Several speakers, including George Coggins and Jack Ward Thomas, called for strengthening old conservation laws. Coggins proposed creating new laws which would provide a clearer mandate for ecosystem management. He also emphasized the importance of congressionally mandated, jurisdictional authority of ecosystem boundaries in landscapes which exhibit multiple ownership. Thomas and Mike Dombeck identified the need for streamlining the bureaucratic process, and changing the laws to fit the new management scheme.

Coggins argued that it would not be sufficient simply to write new conservation laws, but those laws must also be enforced even if enforcement entails costly litigation. Louisa Wilcox discussed the litigation approach, giving examples of litigation over Yellowstone wildlife and geothermal resources that cross park boundaries.

The second approach emphasized the importance of a participatory public in directing policy makers in ecosystem management. This group, which included Steve Daniels and Doc and Connie Hatfield, called for a radical change from the present adversarial system of competition, polarization, and antagonism toward the non-adversarial politics of cooperation and consensus building referred to by Shannon (1991). She argued that such a "bottom up" approach is highly sustainable because it enjoys a high degree of public legitimacy and would save the resources currently expended on litigation and appeals.

Ted Stewart stressed the importance of state involvement. He pointed out that states have broad powers over wildlife, water, and land use. States also can have cooperative agreements to share information and wildlife habitat management. Stewart emphasized that ecosystem management cannot succeed with only federal power, that states must take the lead, and that landowners must not be repressed. The landowner issue was restated by Thomas.

Somewhat in opposition was Coggins' view that states had a poor record in cooperation and action on environmental issues.

Finally, long-term and large-scale conservation goals will be difficult to attain in a global environment of increasing population pressures, increased resource use, and high inequity between the social, ethnic, and gender classes (Meffe et al. 1993, Sieving et al. 1994).

CONCLUSION

In conclusion, from a policy perspective, ecosystem management is a viable proposal; however, its implementation will be difficult due to the required social and legislative changes. It is also apparent that sustainable ecosystem management is intimately linked to an ecologically literate and participatory public. However, during the process of creating participation, it may be prudent to establish stronger conservation laws and utilize the adversarial system to keep the agencies accountable for their actions.

We feel that scientists and agency personnel must take the time to be good educators and develop communication skills if ecosystem management, as expressed in the symposium, is to be successfully carried out.

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Legal and Political Complexities of Ecosystem Management

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Abstract

With differing legislative mandates, federal agencies will have difficulty sharing authority to further transboundary EM although BLM and Forest Service heads Dombeck and Thomas aver that there will be renewed effort at cooperation and communication. State jurisdiction over lands complicates the problem further, and Stewart contends that the state should take the lead in EM. The agencies have no authority to impose ecosystem management on private land, and the challenge is to convince property owners of the benefits of EM. According to Coggins, private property rights are not absolute, are subject to the rights of other community members, and the Supreme Court has generally favored social interest. However, in recent years the judiciary has moved more toward a property-rights position.

Coggins stressed that much of public input will be adversarial and antagonistic to public agencies. He believes that new legislation will be needed to define the level of public participation. While stressing the importance of collaboration between agencies and other groups, Thomas pointed out the impediments posed by the Federal Advisory Committee Act. A number of speakers commented on the need for legislative change.

INTERAGENCY RELATIONSHIPS

George Coggins outlined out some of the potential difficulties inherent in the present system of federal land management. Federal lands are managed by different agencies with differing legislative mandates. They have often been at odds with one another and will probably resist giving up or sharing authority in order to further transboundary EM. However, while agencies do have the authority to practice EM within their jurisdictional boundaries, they have limited authority to practice it outside their borders.

Mike Dombeck agreed that there were agency jurisdictional issues to work out, but felt that since all agencies should have the common goal of protecting the health of the land, effective communication between agencies would be the key to reaching that goal. He pointed out that communication should be present anyway. As one step toward improved communication, he proposed employee exchanges between agencies. Jack Ward Thomas supported this as well. The general theme of interdisciplinary cooperation was expressed throughout the symposium. Thomas commented that the President would like to see combined agencies. This would encourage EM or at least facilitate EM on federal lands by alleviating some jurisdictional problems between agencies.

Interagency cooperation is a key component of successful EM. From Chris Risbrudt's call for better interaction among landowners, state, and federal agencies, to Louisa Wilcox's views on ownership and management, to the final panel discussion with various agency heads discussing movement of personnel among their respective departments, the need for collaboration and teamwork among parties was apparent throughout the symposium.

The range of interagency interactions in the past has been quite broad. Agencies all have their own legal mandates and institutional biases. However, as Coggins discussed, even though every agency has its own defined management objectives, governments have sometimes implemented transboundary agreements. These have included managing flood plains, controlling hydropower, and enforcing such regulations as the Migratory Bird Treaty Act and the Endangered Species Act (ESA). But beyond the implied provision of such laws as the National Environmental Policy Act (NEPA), the Federal Land Policy and Management Act (FLPMA), the National Forest Management Act (NFMA), and the Clean Air and Water Acts, no explicit statutory directive for transboundary management oversees or enforces such programs. For example, although NFMA asserts that coordination by the USFS with outside agencies should be part of decision-making processes, the USFS rarely extends this coordination beyond consultation (Keiter 1989). This issue was also addressed during congressional oversight hearings in 1985 that focused on the lack of interagency interaction. The result was Congress applying more pressure on the agencies to cooperate and implement EM (Goldstein 1992).

Current interactions among agencies need to be examined on a case-by-case basis. The number of involved coalitions can be quite high. For example, more than 40 organizations and numerous additional individuals make up the Greater Yellowstone Coalition (Clark and Zaunbrecher 1987). As Coggins pointed out, each different unit may retain the belief that it is a sovereign entity. Although current law does legitimize putting transboundary EM into practice, adjacent parties have worked together only when circumstances have forced them to (Keiter 1989). Examples include interagency cooperation on issues such as pollution (acid rain), migratory animals (Yellowstone elk herds), and outside impacts (upstream mining or logging).

The emphasis on agencies and parties coming together to discuss common interests was evident throughout the symposium. The Colorado Plateau break-out session discussed a bottom-up approach of gathering the involved parties to formulate concerns, goals, and objectives. This approach was endorsed by Oregon ranchers Doc and Connie Hatfield. Connie's description of ranchers and biologists coming to a realization that they shared similar goals with regard to stream erosion was an elegant case in point. Thomas described another approach of facilitating communication through agency personnel interchange. He provided numerous illustrations of people at various management tiers working together to further EM goals.

The Colorado Plateau group discussed an approach to formulating interagency cooperative management plans similar to those used in such emergencies as wildfires or searches and rescues. This type of coordination would supersede existing intra-agency regulations and would be overseen by a non-agency council (e.g., the National Wildfire Coordinating Group). Such interaction has already been demonstrated in areas such as the Greater Yellowstone Ecosystem (GYE) with such issues as exotic species control and endangered species management (Varley 1993). The attitude was recently reinforced by the U.S. Fish and Wildlife Service's plan to implement EM by establishing partnerships with other agencies and private interest groups (U.S. Fish and Wildlife Service 1994). Such agreements are not limited to national interests, as evidenced by the United Nations' establishment of biosphere reserves encompassing numerous jurisdictions (Sax and Keiter 1987).

Numerous speakers (Dave Roberts, Mike Ruggiero, Ted Stewart, Louisa Wilcox, and Mike Dombeck), also mentioned the idea of data sharing. This is seen as a way of facilitating transboundary management, especially when significant cumulative effects need to be considered. Agencies would have to map and collect data cooperatively, thus ensuring a standard format. Information would then be made available to all land managers, including state agencies and private property owners. GIS was mentioned as a way to map and share data and to monitor long-term effects.

STATE LANDS

State jurisdiction over lands also complicates the proposition of EM. Ted Stewart mentioned that states should take the lead in implementing EM, but the requirements associated with School Trust Lands complicate the issue. Managing these lands for both public school funds and EM will be no easy task. The Book Cliffs initiative was just one of many examples given that show that the State of Utah has been practicing EM to some extent.

PRIVATE PROPERTY

A number of speakers discussed the complexities of extending EM to private lands. The main challenge is convincing private property owners of the benefits of EM. Coggins commented that agencies have authority to practice EM, but only within their own boundaries. The organic legislation for federal land-management agencies only allows for consensual agreement with adjacent landowners, and agencies lack true coercive powers. Coggins also stated that western landowners will resist federal- government coercion. Thomas, on the other hand, stressed that the U.S.D.A. Forest Service (USFS) seeks no additional authority over private property. He feels there are better ways of encouraging EM practices. The job of the USFS is to provide technical help and guidance. Doc and Connie Hatfield reiterated this by saying that agencies can influence and educate property holders much like extension specialists and can also help in monitoring. Agencies help people understand that EM does not mean an adverse change in lifestyle but may in fact improve their chosen lifestyle.

Louisa Wilcox opined that the original Greater Yellowstone Coordination Committee failed because private landowners did not understand what they were trying to accomplish. She stated that agencies need to take the lead in helping people understand what EM is and how it can benefit them. She also believes that economic incentives would have to be used to compensate land owners for some regulatory land-use restrictions. Bret KenCairn also reiterated the importance of agency-directed education and incentives for

rural communities. Examples of compacts and land swaps were given by many speakers as ways to simplify jurisdictional problems related to private lands.

Several issues related to private property rights may complicate the implementation of EM. Specifically, private landowners are likely to react negatively to any actual or perceived increase in land and resource regulation. There is also the question as to when government regulation of private land constitutes a "taking."

Private landowners, especially in the West, have little tolerance for government interference. As noted in the symposium, "In the West, private landowners have the best lands and the worst attitudes (toward EM)." According to Maughn and Nilson (1993), "Reactionary movements against federal land policy have been a recurring phenomenon in the public-land states of the West where the federal government typically owns at least half of the land." Movements such as the Sagebrush Rebellion and the Wise-Use Movement are clearly indicative of some western landowners' attitude toward federal-government involvement.

Coggins emphasized that private property rights are not absolute and are subject to the rights of other community members as expressed through regulations. Yet, private property rights are protected in the fifth amendment of the U.S. Constitution, which states that "private property shall not be taken for public use without just compensation." The contradiction between private property rights and the government's right to regulate private land leads to the "takings issue."

Regulatory takings may occur "when government regulation restricts what owners may do with private property." Regulatory takings occur when "government regulation lowers the value or interferes with the use of property interests without actually taking physical possession or usurping property title" (Coggins et al. 1993). Yet, regulatory takings remain difficult to define. Legal precedent has placed regulatory taking of property on a continuum with the power of eminent domain (physical taking of property). Lawyers attempt to ascertain whether a regulation goes "too far" and warrants compensation.

The Supreme Court has generally favored social interests over property rights, except in the early 1900's and during the conservative renaissance of the Reagan and Bush years. However, even with the support of conservative politics, takings compensation has been supported only when the value of private property has been severely diminished. For example, two cases supporting compensation for regulatory takings in 1990 found 95% and 99% reductions in value. During the symposium, Coggins reiterated that legal support for regulatory-takings compensation was unlikely. He noted that takings compensation was improbable unless all value was taken or if property itself was taken.

COLLABORATIVE PARTNERSHIPS BETWEEN AGENCIES AND THE PUBLIC

An important ingredient in the EM decision-making process, as indicated by many of the speakers at the symposium, is the role of the private citizen. According to Steve Daniels' presentation, affected people should have a voice, and agencies should practice a politics of inclusion, balancing public participation with opinions of scientific expertise, and characterizing a voluntary rather than coercive or adversarial process in land-management and environmental policy making. Such a process would stress social learning as a means of working through problems. Since EM currently is more vision than actual practice, there exist only legal precedents, actual agency behavior, and personal opinion as limited examples from which to determine what level of public participation has been or will be included, and to what degree these inputs will be allowed to influence the direction of EM.

From a legal standpoint, George Coggins stressed that the main direction of public input has been and will continue to be through the adversarial, rather than voluntary, process. A clash between agencies and private landowners or interest groups over unwanted government intrusion or undesirable land-management policies is the most likely result. This tension will continue if agencies approach EM in the same bureaucratic tradition of the past. Agencies are perceived as believing that they must convince the private property owner and public that their concept of land management is the correct and beneficial solution to resource problems, rather than including the private individual in the management process as an active participant in determining the goals and directions of any EM strategy. This perception of agency behavior was mentioned in presentations by Doc and Connie Hatfield and Louisa Wilcox.

If agencies are to include private land owners and affected interests in the process of creating EM goals and practices, thereby giving dispute-resolution strategies a chance to work, Coggins suggested that additional legislation may be needed to define the level of public participation that will be allowed, and what legal recourse individuals will have to force agencies to allow public input, including collaborative commissions.

Thomas discussed the role of the Federal Advisory Committee Act of 1972 (FACA) which details the extent to which advisory commissions can be created, their powers, and who has the authority to form these commissions (P.L. 92-463, 86 Stat. 770). Specifically, advisory commissions are not empowered to force agencies to comply with their recommendations except under special acts of Congress or charter by the President. According to FACA, all matters under the consideration of advisory commissions should be determined by the official, agency, or officer involved and any actions taken or policies resulting from committee recommendations will be made solely by the President or other officer of the federal government (P.L. 92-463, 86 Stat. 770; s.9). Essentially, FACA limits the power of private influence expressed through advisory or collaborative commissions. Any advice coming from such commissions may or may not be acted upon.

A working example of agency collaboration with private interests that includes private and community concerns in resource management is the Applegate Partnership described by Bret KenCairn. Collaborative resource-management strategies are still the exception rather than the rule, as agency collaboration with private interests is a voluntary process,

done usually in response to previous legal gridlock over a resource conflict. A good example was provided by Louisa Wilcox. Resource dialogues in the GYE are usually crisis driven, implying that agencies and private interests come to the table as a last resort rather than risk giving up their individual autonomies. She also characterized agency administrative behavior as having few incentives to enter into such cooperative collaborations.

Obstacles to the creation of agency partnerships with private interests stem from the autonomy that agencies have in the exercise of their management strategies within agency boundaries. Agencies are just as loathe to give up their autonomous jurisdiction within agency reservations as private land owners are on their lands. One must question what power if any these partnerships will be allowed to have over actual agency policies and management decisions, considering the limits imposed by FACA. Unless an act of Congress gives more power to advisory commissions, private land owners and communities involved will only have the power to advise agencies, with little other means within commissions to compel agencies to act on their interests.

THE LEGAL COMPLEXITIES OF IMPLEMENTING EM

As Steve Daniels noted, one of the major challenges of implementing EM is the underlying legal complexity. The legal complications arise because the statutes which provide direction for federal natural-resources management were enacted prior to the official acceptance of EM as a guiding directive. Many symposium participants addressed the issue of whether or not the existing statutes are a sufficient base upon which to build the emerging concept of EM.

According to Thomas, attorneys have told the USFS that in trying to implement EM, the USFS is "diligently pounding square pegs into round holes. The law was not designed for it exactly." He further stated that the USFS "operates under a number of natural-resource laws that are somewhat confusing and conflicting to say the very least, not only the legislation itself but the evolving case law." As a result, he said that the USFS is working with the Office of General Counsel to determine if there is a way the agency can use existing laws to implement EM more effectively.

Thomas' viewpoint was generally shared by Coggins, yet Coggins stated that existing statutes are adequate to apply EM within agency borders. However, due to the lack of specific legislative guidance, if EM is to become a transboundary reality, Coggins believes that additional legislation will be required. Nevertheless, he stressed that the constitutional basis for extending federal influence beyond federally reserved lands is "beyond reasonable challenge," referring to the Property Clause, the Treaty Clause, and the Commerce Clause. Although a constitutional basis for transboundary management exists, he said that the agencies themselves have no authority to coerce land owners to comply with EM even though they may advise them to do so. Agreeing with Thomas, Keiter (1990) says that evolving case law has inconsistently dealt with transboundary EM, so the legal questions are far from settled at this time.

Wilcox mentioned an example of a statute which may inhibit EM. The 1872 Mining Law is a "critical enemy to EM." She then mentioned that the Wilderness Act of 1964 has been instrumental in building up the GYE by providing a means to set aside core areas around which less restricted lands can be used to further EM. Legislation that has promoted land exchanges, such as the recent Gallatin Range Consolidation and Protection Act of 1993 (Public Law 103-91), has also been important for consolidating core areas. That law was enacted in part to consolidate grizzly bear habitat in the GYE.

According to Jack Stanford, ESA requirements have been used as a springboard to implement EM in Montana's Flathead Basin. However, in order for the greater community to accept those requirements, reliable science must support all related management decisions. Equally as important, the research must be presented clearly to the local people. In his view, if this is done correctly, local people are likely to support EM.

CONCLUSION

The issues discussed here demonstrate the legal complexities of EM. Strong relationships, both legal and informal ones, will be necessary for its implementation. Cooperative relationships are crucial for managing across political and legal boundaries. By reviewing various agencies' views and the laws defining those views, this symposium has helped to pave the way towards better cooperation among all parties interested in EM.

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EPILOGUE

What Have We Learned?

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Abstract

Although it is commonly implied that there cannot be a single, generally applied definition of ecosystem management (EM), recognition (1) of what constitutes a system, (2) that ecosystems are a special class of the genre called "systems," (3) of a definition of management, and (4) that natural resources on public lands and common-property resources are managed to satisfy societal values, means that EM can be defined as "the skillful manipulation of ecosystems to satisfy specified societal values." Definitions vary primarily in the value-satisfying aspect. Determination of ecosystem limits is arbitrary. Establishing management goals determines the ecosystem(s) to be managed.

To set some desired future condition or trajectory as a management goal, and extracting goods and services, implies an ability to predict. Prediction requires modelling and individuals capable of designing models and exercising them. Management will need to be adaptive and closely monitored.

Successful EM efforts are originated and planned at the local level, involve effective communication, and cooperation across land-ownership boundaries.

Characteristics of the Intermountain Region which the break-out groups considered likely constraints on EM are the diversity of public values, a positive attitude toward growth, competing values among the agencies, and inadequacy of scientific information. Positive traits include the high percentage of public land, growing recognition that the problems need to be solved, and a strong commitment to the land and its resources.

INTRODUCTION

The 17 presentations made at this symposium add to the already extensive flow of publications on ecosystem management (EM). There is a widespread impression among those who have kept up with this flow that what constitutes ecosystem management is in the eye of the beholder, and that each person's definition differs from the others. Dombeck comments that ten different people in a room will have ten different definitions.

In fact, there is a great deal of convergence within all of this literature, including the papers of this symposium, and one now begins to hear the same ideas put forward repeatedly. They may vary in detail or some particulars, but it seems clear that there is a limited set of principles emerging.

Some of those principles were referred to explicitly in the 17 papers of this symposium. Others were only implied by the speakers and have not yet been pointed up for emphasis. In yet others, implications for actually carrying out ecosystem management on the ground were not deduced and highlighted, but nevertheless were present.

It seems worthwhile here to distill out those principles and deduce those implications. The papers of this symposium, discussing both the natural-scientific and policy aspects, provide an especially useful collection for such a distillation.

WHAT IS ECOSYSTEM MANAGEMENT?

Although a number of the speakers—e.g., Salwasser, Kessler, Stanford, Stewart, Dombeck—and the Bentley et al. synthesis offered definitions of ecosystem management, the break-out sessions on the Great Basin (West and Rasmussen) and Colorado Plateau (Schmidt and Rusmore) both concluded that there is a need for a more succinct definition of the process. In order to develop a definition sufficiently general to embrace those of Salwasser, Stanford, Kessler, Dombeck, and the ten people in Dombeck's room, it is necessary to disaggregate the two words in the term, explore the meaning of each, and then recombine.

First, ecosystem. It is a special case of the more general category of entities called systems all of which are considered

to have four characteristics. (1) A system is a collection of interacting parts that function together to produce one or more results or outputs. (2) Since the parts interact, the implication is always present that manipulating any one part will affect the other parts, and the results or outputs of the whole. (3) There are no closed or self-contained systems in the sense that they can continue to function without inputs and outputs of energy and/or matter. (4) Systems have limits through which the inputs and outputs flow.

This textbookish definition may seem wearisome. But it needed to be said because it has very important implications for carrying out ecosystem management in the real world. These are contained in Robert's paper, but were not highlighted by him; and by Stanford who does highlight them. I will point out these implications below.

An ecosystem is a special kind of system in which the entities are living and dead organisms, including people, and physical components such as water, geology, soils, and atmosphere. As with other systems, the components of an ecological system interact and function to achieve several results. Among the latter are the capture, transfer, and dissipation of energy; and the cycling of chemical elements and compounds. At a different complexity level, the results are to structure populations of plant and animal species, and plant and animal communities made up of those populations.

As with other systems, there are no closed ecosystems, and delimiting them is an arbitrary human act. Hence, an aquarium, a log, a pond, a watershed, a forest, a landscape, a biome can all be declared ecosystems without contradicting the above definition.

Next, the word management. My dictionary gives essentially the same definition as Salwasser's: "the process of taking skillful actions to produce desired outcomes." So we could pose the first iteration of a definition: ecosystem management is the skillful manipulation of ecosystems to produce desired outcomes. In my view, this is valid in principle and general enough to capture the many variations out there. But it is also so abstract as to carry very little informational content, and does not explain the variations. So we need to delve further.

When speaking of resource management in western U.S., more often than not we are referring to resources that occur at least in part on public land, or about public-property resources like wildlife, water, and air. In both cases, they are owned by society at large. Hence we are managing public resources guided by *public* policies. Public-policy analysts are increasingly pointing out that we do not manage public resources for themselves. Rather we manage the resources to satisfy societal values (Wagner 1994). Hence that satisfaction is the "desired outcome" of managing public resources. And we can now pose our second iteration of ecosystem management as the skillful manipulation of ecosystems to satisfy specified societal values.

It is in the value-satisfying aspect that definitions vary. As Salwasser comments, "Ecosystem management is variously defined by those who are shaping its course." And Thomas remarks that "Ecosystem management is more about people than anything else."

Definers commonly couch their definitions in terms of their own values, and it is the differences in individual and group values that produce the definitional differences. Members of the environmental community stress the values of preserving biodiversity (as have some of our speakers), ecosystem health and integrity, and sustainability; and make the production of goods and services for humans contingent upon these (cf. Grumbine 1994, Wilcove and Blair 1995). Adair et al. point out the emphasis on these criteria by Wilcox. Agency employees and others concerned with managing for goods and services emphasize that these outputs are an essential part of EM, again as have some of our speakers. Thomas emphasized that "We have no option but to move forward with natural-resources exploitation." Bentley et al. perceived that the definitions offered by the symposium speakers vary across a continuum between stress on preservation and stress on utilization.

Ecosystems vary across a spectrum of human use, bounded on one end by preservation and nonuse by humans, and on the other end by complete alteration, as in cultivated agriculture. Which of the above criteria are included in a definition of EM for a given area depends on where it falls along that spectrum. For an area managed as a nature reserve without commodity use, preserving biodiversity and maintaining ecosystem integrity would be appropriate goals for management, and criteria for an EM definition. Management for commodity production would not. But we can engage in ecosystem management on an Iowa cornfield or Idaho aquaculture operation. In these cases biodiversity and ecosystem integrity would not likely be management goals or relevant definitional criteria, but commodity output obviously would be.

In the Intermountain West, where cultivated agriculture is limited, the most extensive commodity uses are timber harvest and livestock grazing of native biotas. Human use is intermediate in the use spectrum, and management goals and definitions may well include all of the above criteria.

The bottom line is that most definitions are ad hoc, specific to the value-based management goals of each area. The only definition that embraces the many variants of ecosystem management, with their varying criteria, is something general on the order of Iteration 2. And there is no a priori imperative to include management for biodiversity, ecosystem health and integrity, and commodity production in every ecosystem-management effort, and therefore to specify them in a general definition. The one exception might be sustainability. Hence Iteration 3 might be the skillful and sustainable manipulation of ecosystems to satisfy specified societal values.

The value aspect is also an important determinant of what is ultimately delimited as an ecosystem to be managed. In order that management can satisfy values, it must be assigned management goals to achieve that end. If a management goal is to perpetuate a threatened or endangered species of pupfish in a Death Valley spring pond, the appropriate area to delimit as the ecosystem to be managed may be a limited surface area that affects the pond and perhaps a subsurface aquifer that feeds it. In terms of the management to be applied, it would not be useful or practical to declare the whole of Death Valley as the ecosystem to be managed.

On the other hand, if the goal is to manage the metapopulation of desert bighorn sheep which are distributed among, and interchange between, the several small mountain ranges of Death Valley, it could well be appropriate to delimit the entire valley as the system to be managed. But that broad focus might not be useful for intensively managing the small microcosm in which the pupfish occur, and the pupfish management perspective would not be useful for managing the bighorns.

The bottom line is that there is no a priori basis for circumscribing an ecosystem to be managed. Salwasser, Kessler, Roberts, and Risbrudt all make this point. Delineation of the system is determined by the management goal(s). A priori choice of a watershed or forest stand, an administrative unit such as a national-forest district or BLM management area, or some convenient, recognizable geographic area, independent of a specified management goal, may not coincide with some management goals, and others goals may exceed the limits of such an area. As Wilcox points out, the borders of the Greater Yellowstone Ecosystem are set to address management problems of highly mobile large mammals like elk and grizzly bear, and in the process subsume two national parks, parts of seven national forests, three federal wildlife refuges, and BLM, state, and private land. Stanford points out that water quality in Flathead Lake is the management goal. Hence the designated ecosystem is the Flathead Lake basin, or watershed, and its airshed.

In short, establishing management goals determines the ecosystem(s) to be managed. Those goals may include production of goods and services, and the desired present and future conditions or trajectory of the system (e.g., biodiversity, health and integrity, sustainability). Who establishes those goals is a separate question to be discussed below.

THE NATURAL-SCIENCE COMPONENT

Most authors writing on ecosystem management comment that the approach entails a stronger ecological or scientific component than has characterized much of traditional resource management. Risbrudt and Mosesso make this point. But it is Roberts' paper that raises awareness of just how demanding the scientific capability will need to be.

Numerous authors point out that the use and management of designated ecosystems must take place in the context of desired current and future ecosystem conditions: diversity, sustainability, health, integrity, resilience, etc. (cf. Salwasser, Kessler, Roberts, Risbrudt, Mosesso). Roberts speaks further of a desired future trajectory.

To set some desired future condition or trajectory as a management goal, while at the same time extracting goods and services, implies an ability to predict the effects of uses and management on such conditions or trajectory. (It was in anticipation of this point that the system definition above stressed the interrelationships of the parts, and the fact that manipulating one part would affect the others.) The implied ability to predict carries the further implication of a sufficient scientific understanding of the system's structure and function to permit prediction, and a mechanism for predicting. That mechanism, according to Roberts, is simulation modelling.

Stanford commented in his oral presentation that generalizing the behavior of a system from a long data set is preferable to predicting that behavior a priori with models. One can hardly disagree with that view. And the successful management steps that he describes were clearly guided by the ecosystem understanding provided by the many years of excellent research in the Flathead Lake Biological Station.

But there will not be extensive databases for most natural-resources systems that provide an understanding of their behavior empirically. Consequently, in order to get programs underway and predict the effects of management efforts, there will need to be models structured with what data are available, data on systems sufficiently like the one under consideration, and/or knowledgeable ecologists' best judgement. There is not time to wait for 20-year data sets in most cases.

Moreover, each area to be managed will require the services of individuals who can structure and exercise the needed models. Roberts' paper provides a preliminary outline of one unique, conceptual approach which, if used, would need considerable developmental effort before becoming operational. And once in operation for one area, it would need to be adapted for other sites with different ecosystems and management goals. It could not be considered an off-the-shelf, universally applicable package.

Roberts' innovative paradigm also has important implications for the question of delimiting an ecosystem to be managed. In his scheme, each management goal for an area is modelled and managed as a separate system ("element"). Hence the approach becomes a collage of variously interacting system models. There is no single spatial or geographic area that is modelled and managed as a discrete unit.

I am not aware that the subtlety, complexity, and magnitude of these scientific needs have been specified or pointed out by the many previous papers appearing on ecosystem management. Roberts' and Stanford's papers raise our awareness of these realities.

Risbrudt comments that there is not time to research all of the questions before moving forward with management. Hence models will need to be built and management will need to be initiated with what information is available, i.e., adaptive management as Salwasser and Kessler point out. This is clearly the approach described by Stanford for which there was little research information on the Flathead Basin system when the first management steps were taken.

Since management efforts will need to be provisional, or viewed as hypotheses, the systems will need to be monitored closely. Management directions will need to be modified if new research so indicates, or if monitoring detects trends away from management goals. Salwasser, Kessler, Wilcox, and Mosesso all comment on the indispensable role of effective monitoring.

HOW IS IT INITIATED, WHAT MAKES IT WORK?

While it is risky to generalize from the small sample presented at this symposium, it is tempting to infer the emergence of principles which point to conditions prevailing in those cases of where EM is working. Among the case

studies presented in Session 2, the ones that appear to be working, or at least making some progress, are the Applegate Partnership described by KenCairn, the Trout Creek Mountain Project described by the Hatfields, and the Flathead Lake program described by Stanford.

One feature common to all of these is that the impetus to go forward arose at the local level, with representatives of the concerned interests coming together in recognition of a problem and willingness to collaborate in a solution. The one resounding failure among the case studies was the Greater Yellowstone effort described by Wilcox. As she pointed out, this attempt was initiated by administrators of the federal agencies with jurisdiction in the area.

Several of the other speakers commented on this same principle. In Dombeck's view, ecosystem management "... involves coordinated planning at the local level, forming partnerships ...." Stewart remarked that "... we are doomed to failure if we at the state or federal level see it as a mechanism of `central planning.' We must involve local governments and citizens every step of the way." KenCairn decried the fact that "The political reality ..." facing community-based, resource-management efforts "... is the overwhelming momentum behind centralized, top-down approaches ...." And Schmidt and Rusmore reported the Colorado Plateau's break-out-session conclusion that implementation must begin at the local level.

What KenCairn calls "community-based, resource-management" approaches has been termed "constituency-based, multi-resource management" (Behan 1990) and "interest-group pluralism" (Wagner 1994) by other authors who consider it an emerging paradigm for policy setting in natural-resources management. It consists of local representatives of interest groups coming together to define goals, set policy, and plan management. Daniels and Walker, using their term "collaborative learning," provide an excellent example of how the paradigm could work in ecosystem management.

In commenting that an important role of science in ecosystem management is to define what outputs are possible from an ecosystem (Salwasser: "ecosystem capabilities"), Salwasser and Roberts both see a pivotal role for science at the very beginning of the planning process. And in projecting those outputs, the importance of modelling is once again implied. Moreover, these authors not only specify that the scientists in the process should project the consequences and feasibility of alternative management options, but they should also not advocate personal preferences among the options (Roberts: do not confuse value judgments with science).

The next question arises as to whether there is any general pattern as to what person or persons initiate the local group efforts. In the case of the Trout Creek Mountain Project, it was evidently the Hatfields who precipitated the Portland meeting. Jack Shipley, "a local environmentalist," apparently initiated the Applegate Partnership. Stanford attributes impetus for the Flathead Lake project coming from a "citizen-based steering committee." Thus, in one case it was two members of the user groups, in another a member of the environmental community, and in a third a committee of local citizens. In all cases, they were local people well known to the participants in the group dynamics.

Daniels and Walker describe at length the communication skills needed in collaborative learning, but do not generalize the nature or source of the initiator(s) or mediator(s). Behan (1978) contends that nonadvocating, impartial agency representatives should assume this role as do the Fitts et al. and Kelson et al. syntheses, and McAnninch and Parker (1991) describe a case where an agency representative does so.

A further implication of the voluntary, community-based approach is that it may be an answer to the problems that Coggins raises. The somewhat differing mandates and proprietary tendencies of the federal agencies have been written about by numerous authors (cf. Sax and Keiter 1987, Keiter 1989), and were commented on by Coggins and Wilcox. Wilcox and Kelson et al. remarked that the agencies will need to share decision-making power, and participants in the Colorado Plateau break-out session even advocated merging the land-management agencies. Both Thomas and Dombeck aver that the working relationships between their agencies will henceforth be more cooperative and harmonious. Mosesso commented on the need for interagency data sharing. According to Brunson and Reese, participants in the Northern Rockies break-out session sense a recognition among agency personnel at the state level that solution of complex problems now requires collaboration and cooperation across agency lines.

A potentially more problematic reality is Coggins' point that the federal agencies have no statutory authority to compel state governments and private landowners to enter into transboundary, ecosystem-management efforts. The solution to all of these problems may be the voluntary, local-level arrangements like the Applegate, Trout Creek Mountain, and Flathead Basin efforts.

Finally, a strong message voiced repeatedly during the symposium was the critical need for effective communication between, and enlightenment of, the participants in a management effort. Wilcox stressed this need; and West and Rasmussen, and Schmidt and Rusmore reported it as a strong message from their break-out sessions. Wilcox asserts that this is the responsibility of the agencies, and KenCairn spoke of "agency-directed education." Both the Fitts et al. and Kelson et al. syntheses see this as an important function of the agencies. Daniels and Walker point out the difficulties of communicating something as scientifically complex as ecosystem science to lay audiences. But the Flathead Lake project evidently succeeded, Stanford telling us that the local citizens had become comfortable with the nuance of limnological concepts and terminology.

In total, it now seems clear that putting ecosystem management into operation on the ground will involve a collection of individuals with different kinds of expertise and responsibilities:

(1) Initiating a program will require one or more individuals at the local level who can bring together the diverse interests to specify the management goal(s), and conceptualize and plan the effort. He/she/they will need communication and group-dynamics skills, and to have the trust of the constituents.

(2) The process will require the efforts of one or more highly capable ecologists who know and/or can access the scientific data available, carry out needed research, and perform the modelling functions. There may also be a need for one or more economists and sociologists to evaluate the economic and sociological consequences of different goal options.
(3) There will need to be hands-on managers to manipulate the ecosystem(s) once management goals are settled upon. This would appear to be the clear responsibilities of the agencies where public land is involved, and perhaps in the case of private land when and if private land owners voluntarily acquiesce in the broader system goals.
(4) There will need to be one or more individuals responsible for the monitoring. KenCairn recommends employing local people for this purpose. The modelling personnel should specify the parameters to be monitored and the monitoring protocols.

THEMES COMMON TO THE BREAK-OUT SESSIONS

The Introduction at the beginning of these proceedings set the context for the papers by enumerating the environmental and social characteristics of the Intermountain West which pose unique challenges for ecosystem management in the region. It is now of interest to review the extent to which the roughly 180 participants in the three break-out sessions viewed these same characteristics as important factors bearing on the paradigm.

In fact, there was a considerable amount of convergence among the three groups on the most significant challenges and opportunities, and these substantially coincided with the characteristics outlined in the Introduction. Among the lists of four characteristics prepared by each of the three groups as most likely to pose constraints on ecosystem management, the diverse, often conflicting, public values of the respective regions were included in all three. Moreover, Group 3 (Northern Rockies) cited the prevalence of a utilitarian, "growth-is-good" value orientation to resources, and an associated tendency for the political process to produce solutions that are not ecologically optimal.

All three groups rated the inadequacy of scientific information on the regions among their top four potential constraints. Group 1 (Great Basin) also listed as potential difficulties the nonlinear, unpredictable behavior of the ecosystems, and their slow ecological response times to management.

Groups 1 (Great Basin) and 2 (Colorado Plateau) also listed in their top four the conflicting goals and missions of the agencies, and the difficulties of changing these. Reminiscent of comments by Coggins, Thomas, and Wilcox, Group 2 commented on what it perceived as an inadequate legislative foundation for the agencies to operate.

The characteristics listed by each group as providing the greatest opportunities for ecosystems management also showed considerable convergence of thought. Both the Great Basin and Northern Rockies groups concluded that if the bureaucratic and statutory impediments can be circumvented, the high percentage of public land in the region should facilitate ecosystem management.

Both groups also opined that while public values attached to natural resources are diverse and contentious, they and associated political climates are changing, and there is a growing recognition of the need to solve environmental problems. The Northern Rockies group also detected a growing recognition among the agencies on the need for collaboration. The Colorado Plateau group perceived a strong grassroots tie and commitment to the land within the agency personnel.

All three groups recognized rich research opportunities, occasioned by the diversity of natural land types (Colorado Plateau), an extensive array of refuges and relicts that serve as benchmarks (Great Basin), a variety of data and monitoring sites already in place (Colorado Plateau), and a sophisticated scientific technology that is becoming increasingly available (Great Basin).

In total, the three groups pointed out a number of characteristics of the region that could act as constraints on implementing ecosystem management in the Intermountain West. But these same traits contribute to the interest and challenge of carrying it out, and the groups displayed a considerable amount of optimism over this new direction for natural-resources management.

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